OPERATING AND SERVICE MANUAL

MODEL 100

CONTINUOUSLY VARIABLE OSCILLATOR

Serial Numbers 239-

WESTON®

prime source
for precision...
since 1888

WESTON INSTRUMENTS, INC.
a Schlumberger company

MP MASTER
MA35435

TO OPEN
PUSH CENTER RING
UP ½"
& SWING TO LEFT.

Serial Number _____

OPERATING AND SERVICE MANUAL

MODEL 100

CONTINUOUSLY VARIABLE OSCILLATOR

Serial Numbers 239-

First Edition (8/15/67)

Second Edition (11/20/68)

WESTON INSTRUMENTS, INC.
Weston-Lexington Division
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Lexington, Massachusetts 02173

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TABLE OF CONTENTS

Section	Title	Page
1.	Description and Specifications	1-1
1.1.	General Description	1-1
1.2.	Specifications	1-3
1.3.	Plug-in Modules and Accessories Available	1-9
2.	Installation	2-1
2.1.	Initial Inspection	2-1
2.2.	Power Requirements	2-1
2.3.	Fan Operation	2-1
2.4.	Rack/Bench Installation	2-2
3.	Operation	3-1
3.1.	Introduction	3-1
3.2.	Controls and Connectors	3-1
3.3.	Turn-on Procedure	3-1
3.4.	Operating Instructions	3-1
3.4.1.	Frequency Selection	3-1
3.4.2.	Range Change	3-2
3.4.3.	Amplitude Controls	3-2
3.4.4.	Floating Operation	3-2
3.4.5.	External Modulation	3-2
3.4.6.	External Synchronization Mode (Option 05)	3-3
4.	Theory of Operation	4-1
5.	Calibration	5-1
5.1.	Autoshift Mechanism Adjustment	5-1
5.2.	Frequency Adjustment	5-2
5.3.	Amplitude Adjustment	5-4
5.4.	Frequency Response Adjustment	5-5
5.5.	Settling Time Adjustment	5-5
6.	Circuit and Location Diagrams	6-1
7.	Replaceable Parts	7-1

LIST OF ILLUSTRATIONS

Figure	Title
3-1	Test Circuit for External Synchronization
3-2	Front Panel Controls and Connectors
3-3	Rear Panel Controls and Connectors
4-1	Continuously Variable Oscillator

SECTION I

DESCRIPTION AND SPECIFICATIONS

1.1. GENERAL DESCRIPTION

The Weston-Lexington Continuously Variable Oscillator Model 100 is a double-integrator, phase-shift oscillator covering a frequency range from 10Hz to 100kHz. The oscillator amplitude of 12V rms is held constant to ±0.01% up to 50kHz and waveform purity of 50ppm is typical over the operating frequency range. The CVO is also a two-phase oscillator with phase A defined as the reference phase and with phase B lagging phase A by 90° ±0.1° at mid-band. All circuits are fully isolated from the outer case and can be made fully floating with respect to powerline ground by means of a switch provided on the rear panel.

A precision film potentiometer is used for continuous frequency selection providing low noise, high reliability, and a linear scale dial. This continuous frequency variability is combined with an automatic range change feature which automatically switches the range switch to the next higher or lower scale when the frequency dial is rotated above or below the range limit. Thus, unidirectional dial rotation permits scanning the entire 10Hz to 100kHz frequency range without use of the range switch. (A range switch is provided for manual override.)

Fixed amplitude front-panel outputs are provided for each phase at a low output impedance and are capable of driving a wide variety of external inductive dividers without additional amplification or impedance buffering. Plug-in modules provide versatility and permit adding additional capability to handle new

requirements at a later date. A number of plug-ins are listed in Section 1.3. The Weston-Lexington Model 108 Auxiliary Plug-in, or any so listed in Section 1.3., are required to provide internal connections for basic unit operation.

1.2. SPECIFICATIONS

Range	10Hz-100kHz continuously variable in 4 decade ranges.
Controls	(a) Frequency dial with continuous control over a ten to one range; the dial is mechanically linked to the range multiplier switch for automatic range switching, with unidirectional rotation. (b) Four decade range multiplier switch, operable either automatically as described above or manually. (c) Multi-turn electrical vernier provides ±2% frequency deviation.
Main Dial Calibration Accuracy	±1% of maximum dial setting, 10Hz-10kHz ±2% of maximum dial setting, 10kHz-100kHz
Resolution	Electrical vernier permits frequency output to be set to within ±0.01% when using an external counter or Weston-Lexington DRO Model 124 digital readout system.
Frequency Stability Vs. Time	±0.01%/hr. 100Hz-100kHz maximum, at constant temperature and line voltage. ±0.02%/hr. 10Hz-100Hz maximum, at constant temperature and line voltage.
Frequency Stability Vs. Temperature	±0.01%/°C maximum, 100Hz-100kHz ±0.02%/°C maximum, 10Hz-100Hz
Frequency Stability Vs. Line	±0.005% maximum for 10% line variation
Frequency Stability Vs. Load	±.01% below 10kHz ±.025% 10kHz-100kHz } no load to full load
Voltage ØA & ØB	12.11 volts rms nominal supplied at low impedance to: (a) Plug-in module

(b) Front-panel fixed outputs
(c) Rear-panel fixed outputs

Note: The nominal voltage may be varied by using some types of plug-ins. Refer to plug-in specifications for further information.

Resistive Load

60ma rms per phase maximum for specified performance. Current available from fixed output is reduced by plug-in requirements. Refer to plug-in specifications for further information.

Maximum Capacitance Loading for Specified Performance either Phase

500pf	(10Hz-10kHz)	Parallel R_L 1KΩ or lower
1000pf	(10kHz-100kHz)	
300pf	(10Hz-10kHz)	Parallel R_L greater than 1KΩ
600pf	(10kHz-100kHz)	

Ratio Transformer Loading

Both ØA and ØB outputs capable of driving most commercial ratio transformers.

Voltage Accuracy at 400Hz and 25°C

ØA: ±0.05%
ØB ±1%
±0.005% (.0005db) 50Hz-10kHz (option 08)

FREQUENCY RESPONSE referred to 400Hz, ØA

ØA: ±0.01% (.001db) 20Hz-50kHz
±0.02% (.002db) 10Hz-20Hz and 50kHz-100kHz

ØB: ±1% (0.1db) 10Hz-20kHz
±5% (0.5db) to 100kHz

Harmonic Distortion

ØA: 0.005% Max. 50Hz-60Hz and 380Hz-1kHz on X100 range
0.01% Max. 20Hz-50kHz
0.02% Max. 10Hz-20Hz 50kHz-100kHz

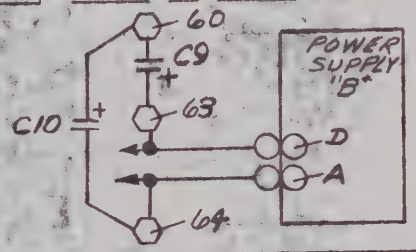
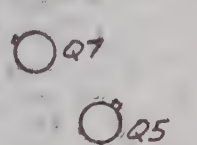
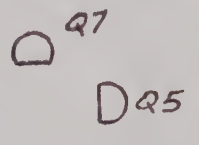
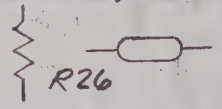
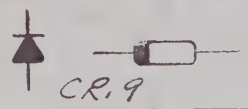
ØB: Twice the values for ØA.

Amplitude Stability Vs. Time at Constant Temperature & Line	ØA: 8 hours: ±0.01% Max. One month: ±0.05% Max. 5-10 minutes: ±0.002% typical (option 01 only) ØB: Stability figures typically twice those for ØA.
Amplitude Stability Vs. Temperature	ØA: ±0.01%/°C, with ±0.005%/°C available as option (See internal options) ØB: ±0.025%/°C
Amplitude Stability Vs. Line	ØA: ±0.005% Max. for 10% line variation.
Cycle-to-Cycle Stability ØA and ØB	Less than ±0.01% including short-term noise.
Tuning Transients	Maximum amplitude transients for rapid, full-scale rotation of the main tuning dial are typically less than 2% (0.2db); normal, slow dial rotation results in considerably lower transient effects.
Output Impedance 12 volt front-panel fixed outputs	ØA: 25 milliohms series .5 micro-henries ØB: 400 milliohms series 2 micro-henries
12 volt rear-connector fixed outputs	ØA: 400 milliohms series 1 micro-henry ØB: 600 milliohms series 3 micro-henries Note: ØA rear connector impedance easily modified to 25 milli-ohms instead of front panel. Instructions given in manual. ØA Amplitude will change ±0.02% above 50kHz for a 0 to full load change on ØB.

	ØB amplitude will change 0.4% at 10Hz, and 0.2% above 30Hz for 0 to full load change on ØA.
Quadrature Phase Accuracy	±0.1° (400Hz-10kHz) ±1° (10kHz-100kHz) $\pm.1° \times \frac{400}{f(Hz)}$ (10Hz-400Hz)
Line Frequency Beat	Less than ±0.01% near line frequency, or multiples, for 110 volt operation, and ±0.02% for 220 volt line.
DC Component	Capacitor coupled output
Overload Protection	All outputs may be continuously overloaded or short-circuited without damage. The oscillator meets all performance specifications after the overload is removed, except full specified amplitude and frequency stability performance requires several minutes for internal temperature restabilization.
Floating Operation	A rear panel switch is provided which disconnects signal ground from the chassis to allow floating operation.
External Modulation	A rear panel switch is provided to allow amplitude modulation by slowly varying control signals.
Rear Panel Connector Signals	(a) 12.11V rms fixed, ØA & ØB outputs (b) Plug-in attenuator outputs (most plug-ins) (c) External modulation input (d) Range switch position contact-closure outputs (e) External synchronization input (option 05) (f) DC voltage output proportional to the operating frequency within each 10:1 frequency range. (option 06)

Temperature Range for Specified Performance	15° - 40° C
Operating Temperature Range	0° - 52° C
Warm-up Time	30 minutes maximum for stated stability
Shock and Vibration	Designed to meet all performance specifications after being subjected to the applicable shock and vibration requirements of MIL-T-945.
Power Requirements	105-130 or 210-260 Volts single phase; 47-66Hz; 80 Watts
Dimensions and Weight	5-1/4" high, 16-7/8" wide, 15-3/4" deep; 30 lbs.

MANUAL CHANGES, MODEL 100 (239-)

PAGE NO.	CHANGE	FROM	TO	SERIAL NO.
--	11-117-164	Ref. Top View Interchange P.C. Boards Amp #4 and Amp #3		239-
7-16 & 04-117-508	--	Add C9 & C10; capacitor, alum., 50μf, 50V; W-L P/N 45-214-001; Sprague; 30D 		239-
7-12 & 04-117 508	--	Delete R6; Installed only for 08 Option		239-
04-117-503 & 504	--			239-
7-9 & 04-117-506	--	Delete: R26 and C4 (Replace R26 with CR19) Diode, Silicon Reference, 18.0V, 750mV; 35-035-001; Motorola; 1N1515A 		239-

INTERNAL OPTIONS

01	±0.005%/°C maximum, ØA amplitude variation versus temperature.
05	External synchronization - 1 volt rms will lock oscillator over a ±0.5% frequency range.
06	Rear panel dc voltage output proportional to operating frequency within each 10:1 frequency range. (a) Linearity: ±1% of max. dial setting. (b) Output voltage range: 1.0 to 10.0 volts (c) Output Impedance: 0.5 ohm max. (d) Load resistance: 1000 ohms min.
07	Guard Driver and rear-panel connector which allows long leads to be used on attenuator ØA output without affecting frequency response. The Guard Driver is capable of driving up to 1000pf at 100kHz.
08	±0.005% (0.0005db) frequency response from 50Hz to 10kHz.

1.3. PLUG-IN MODULES AND ACCESSORIES AVAILABLE

PLUG-IN MODEL NO.	DESCRIPTION
108	Auxiliary Plug-In
109	Single phase divider with moderate accuracy and resolution.
110	Two Phase Divider same as 109 except 2 phases.
111	High resolution and high accuracy.
114	10 volt standardizer, used to set "zero" impedance output level to exactly 10 volts for driving ratio transformers, etc.

ACCESSORY PART NO.	DESCRIPTION
03-117-280-1	Rack Mounting Ears
29-032-229	Connector, 29 Pin female, for use with rear panel output connector.
13-117-063	Printed circuit board extender
02-100-178	Tilt stand assembly.
02-100-174	Stacking bracket, clamps companion equipment on top of CVO-100 case to conserve bench space.
02-117-307	10:1 attenuator box for use with divider plug-ins; 50Ω output impedance.
02-117-308	600Ω impedance adpater box for use with divider plug-ins.

SECTION 2

INSTALLATION

2.1. INITIAL INSPECTION

This instrument has been carefully inspected both mechanically and electrically before shipment and it should be in perfect operating condition and free from all scratches or mars. It should be inspected for physical damage caused in transit to confirm this fact.

2.2. POWER REQUIREMENTS

The Model 100 CVO may be operated from any source of 115 volts 50 to 60Hz. Power requirements are approximately 80VA. If 230 volts is to be used, refer to the block diagram in Section 6 for wiring changes. The unit is supplied with a three-conductor power cable such that the instrument case is normally grounded when the cable is plugged into the appropriate receptacle. The ground wire is the offset pin on the power cable.

2.3. FAN OPERATION

Although the Model 100 CVO is fully transistorized, it is forced air cooled for higher reliability and longer operating life. Because of this fact, care should be taken not to block the fan intake and restrict air circulation. The fan filter should be cleaned regularly to guarantee a long, trouble-free life. The instrument, however, should not be operated where the ambient temperature is in excess of 52°C (125.6°F).

2.4. RACK/BENCH INSTALLATION

The Model 100 CVO is shipped as a bench-mounted instrument. An accessory rack-mounting kit is available which includes the necessary instructions for installation.

SECTION 3

OPERATION

3.1. INTRODUCTION

All instructions and information necessary for the operation of the Model 100 CVO is contained in this section.

3.2. CONTROLS AND CONNECTORS

The front and rear panel controls and connectors are identified and illustrated in Figures 3-1 and 3-2.

3.3. TURN-ON PROCEDURE

To turn on the Model 100 CVO, proceed as follows:

a. Apply ac power to the Model 100 CVO by plugging in the three conductor power cord supplied with the unit from the power input connector to a proper power receptacle.

b. Push power button: The button should illuminate when the unit is on.

3.4. OPERATING INSTRUCTIONS

For normal operation, proceed as follows:

a. Set floating grounded switch on rear panel to grounded position.

b. Set external modulation switch on rear panel to off position.

3.4.1. FREQUENCY SELECTION

To select a desired frequency, set the multiplier switch to the desired range, set the frequency dial to the appropriate

position and set the frequency vernier to its zero position. Use mechanical vernier for fine frequency adjustments and frequency vernier for very fine frequency adjustments.

3.4.2. RANGE CHANGE

a. Manual: The frequency range may be changed by manually operating the multiplier switch.

b. Autorange: The frequency range may also be changed by turning the frequency dial through the section marked "AUTORANGE". Passing through this section in the clockwise direction changes the range to the next lower position, and counterclockwise rotation changes the range to the next higher position.

3.4.3. AMPLITUDE CONTROLS

The signals are brought to the front-panel reference outputs at very low impedance and at a level of 12.11 volts rms. The signal voltage is also supplied to the plug-in module connector at low impedance. (See manual on plug-in module used for further information and instructions.)

3.4.4. FLOATING OPERATION

If it is desirable to connect the outer case of the Model 100 CVO to a point other than oscillator output low, set floating/grounded switch in the "FLOATING" position. (It is not recommended to drive the chassis at any frequency above 10Hz because of excessive beat.) The voltage between chassis and circuit ground should not exceed 100 volts peak or dc.

3.4.5. EXTERNAL MODULATION

Set external modulation switch on rear panel to "EXT. MOD" position. The amplitude should drop to 1/2 its value when switch

is in this position. The modulating signal is connected between pins 4 (hi) and 8 (gnd) on the rear connector. The impedance between pins 4 and 8 is 10K ohms. Set the oscillator to the desired carrier frequency (see section 3.4.1.), and adjust the magnitude of the modulating signal for the required modulation. When high percentage modulation is required, it is recommended that the highest modulating frequency be limited to 1/5,000 to 1/10,000 of the carrier (oscillating) frequency. Maximum modulating signal should never exceed 5 volts peak-to-peak.

3.4.6. EXTERNAL SYNCHRONIZATION MODE (Option 05)

Set external synchronization switch to "EXT. SYNC." position. Check fuse which is 1/32 amp type. Connect synchronizing signal between pins 10 (hi) and 8 (gnd) on rear connector. One volt rms into the 7.6K ohms input impedance is necessary for synchronization. Adjust the CVO frequency (section 3.4.1.) to the synchronizing frequency and observe the Lissajous pattern between the two frequencies as shown in Figure 3-1 below:

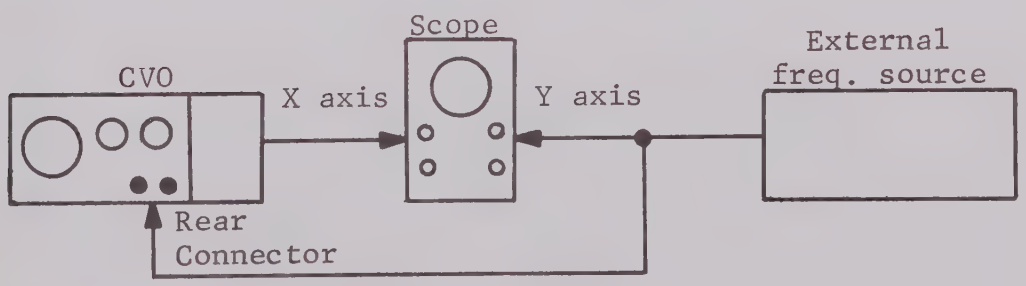
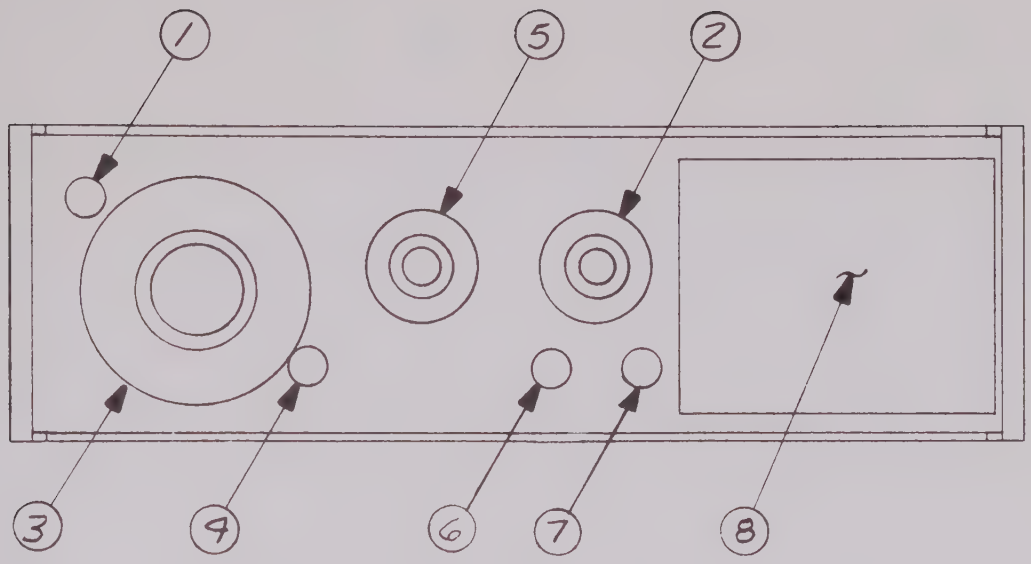


Figure 3-1

Test Circuit for External Synchronization

The oscillator is in synchronization when the Lissajous pattern stops rotating. The oscillator will remain in synchronization for a ±0.5% variation in synchronizing frequency.



1. POWER push button (internally lighted), applied operating power to the unit.

2. MULTIPLIER switch, selects output frequency range.

3. FREQUENCY DIAL adjusts frequency within range setting of multiplier.

4. MECHANICAL VERNIER very fine adjustment of frequency dial.

5. FREQUENCY VERNIER electrical adjustment of output frequency for extremely fine control.

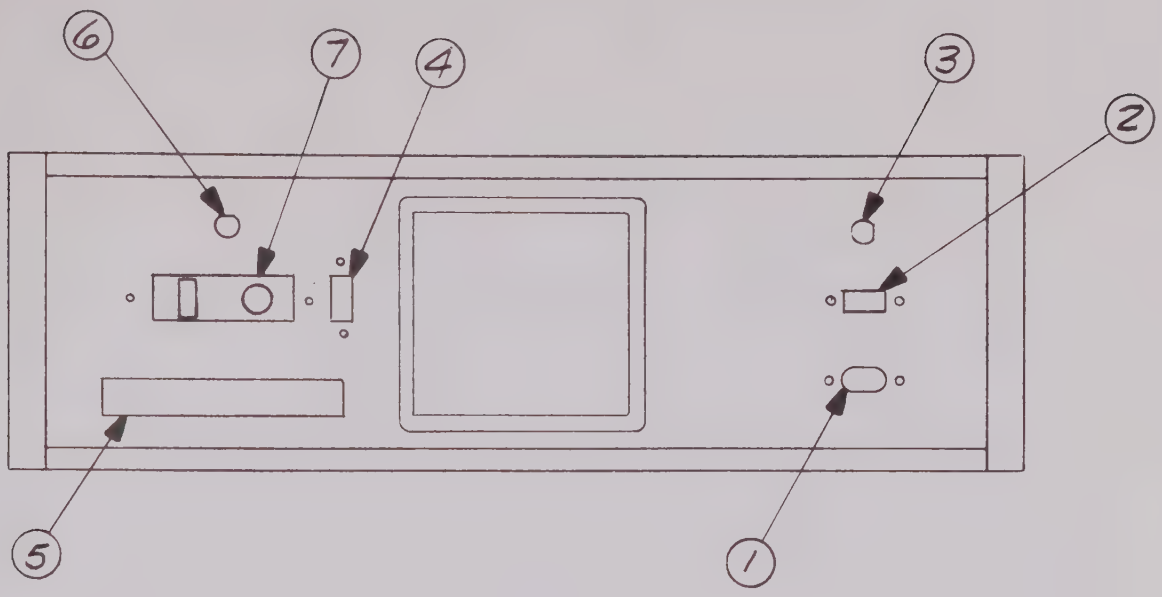
6. PHASE A OUTPUT (J4) main output of unit.

7. PHASE B OUTPUT (J5) lags phase A output by 90°.

8. PLUG-IN CAVITY accepts plug-in modules to extend the operation of the basic CVO.

Figure 3-2

Front Panel Controls and Connectors



1. POWER INPUT connector (J2) accepts the power cord supplied with the instrument.

2. FLOATING/GROUNDED switch (S1) disconnects internal ground from chassis for floating operation.

3. MAIN UNIT FUSE protects internal circuits.

4. EXTERNAL MODULATION switch (S2) allows amplitude to be modulated by external signal.

5. MAIN REAR CONNECTOR (J1) provides plug-in outputs, ØA, ØB, zero output impedance, range switch position information.

6. PLUG-IN OUTPUT WITH DRIVEN GUARD (option 07) allows long leads to be used on attenuator ØA output without affecting frequency response.

7. EXTERNAL SYNCHRONIZATION SWITCH PLATE (option 05) provides external synchronization on main rear connector.

Figure 3-3

Rear Panel Controls and Connectors

SECTION 4

THEORY OF OPERATION

Figure 4-1 shows the dual-integrator oscillator configuration with the addition of the automatic phase-adjusting, amplitude-control feedback loop. Operational amplifiers A1 and A2, in conjunction with R2-C1 and R4-C2 respectively, constitute the integrators; with R2 = R4 and C1 = C2. Ganged precision, infinite-resolution potentiometers R1 and R3 provide continuous frequency variation that is linear with potentiometer ratio and consequently dial setting on each range. Capacitors C1 and C2 are switched in decade steps to furnish decade frequency ranging.

Each integrator furnishes approximately 90° of phase-shift. Operational amplifier A3 supplies the additional 180° to close the oscillating loop. Due to the fact that both A1 and A2 are finite, however, the total loop phase-shift is slightly less than 360°. The additional network from the output of A1 to the summing junction of A3 composed of R7 and R8 in series with the modulator M, supplies a phase-advance, make-up signal.

The current through R7 and R8 is in quadrature with the current through input resistor R5 into inverting amplifier A3, so that for reasonable gains -- say 10,000 -- in A1 and A2, only a small signal is required at E_4 to swing the total feedback vector the incremental phase-shift required.

E_4 is determined by rectifying the output E_2 from amplifier A2, and comparing the result with the potential of a precision zener reference via an integrator I as shown. Use of the integrator supplies a typical gain of over 50,000 for the amplitude-

controlling loop. Integrator output E_5 controls the modulator M, which in turn sets the magnitude of E_4, the incremental phase signal.

Precision infinite-resolution potentiometers R1 and R3 control the frequency at which the loop will oscillate by determining, in conjunction with R2-C1 and R4-C2, the frequency at which net loop gain is unity. R5 is set equal to R6, so that inverter output E_3 equals inverter input E_2. Loading of potentiometers R1 and R3 by integrator input resistors R2 and R4 respectively, is small enough to be neglectable in a first-order analysis. (In the actual instrument, the dial calibration takes into account the small loading effect.) Hence net loop gain is unity at the frequency f_o at which the absolute value of the (identical) integrator gains ($\frac{1}{2\pi f_o R_2 C_1}$ and $\frac{1}{2\pi f_o R_4 C_2}$) are equal to the (identical) attenuations of ganged potentiometers R1 and R3. Thus $E_1 = E_3$ as well since the attenuation through R1 is exactly compensated by the gain through the integrator (R2-A1-C1). E_2 is taken via a precision divider as the main oscillator output E_{01}. E_1 is used -- via another divider -- as a quadrature output E_{02} for applications in which such an output is desirable -- gyro supplies, calibration of phase-sensitive voltmeters and similar measurements areas.

Use of the precision infinite-resolution potentiometers for frequency control provides low-noise performance, with reliability that wirewounds would be unlikely to afford (the potentiometers employed are rated for in excess of 5 million revolutions). Use of potentiometers -- as opposed to rheostats or variable capacitors -- also makes possible a linear frequency dial scale, plus low, virtually constant circuit impedances even at the lower frequencies.

Integrator amplifiers A1 and A2 are stabilized at 6db/octave up to 150 kHz. The slope changes to 12 db/octave from about 150 kHz to within two octaves of crossover which occurs at about 5 MHz, changing to 6 db/octave near crossover. The 12 db/octave stabilization in the instrumentation oscillator application furnishes high loop gain and full drive to higher frequencies, plus lower, wide-band noise and greater freedom from rate-limiting problems, than would be possible with the same closed-loop bandwidth using more conventional 6 db/octave stabilization.

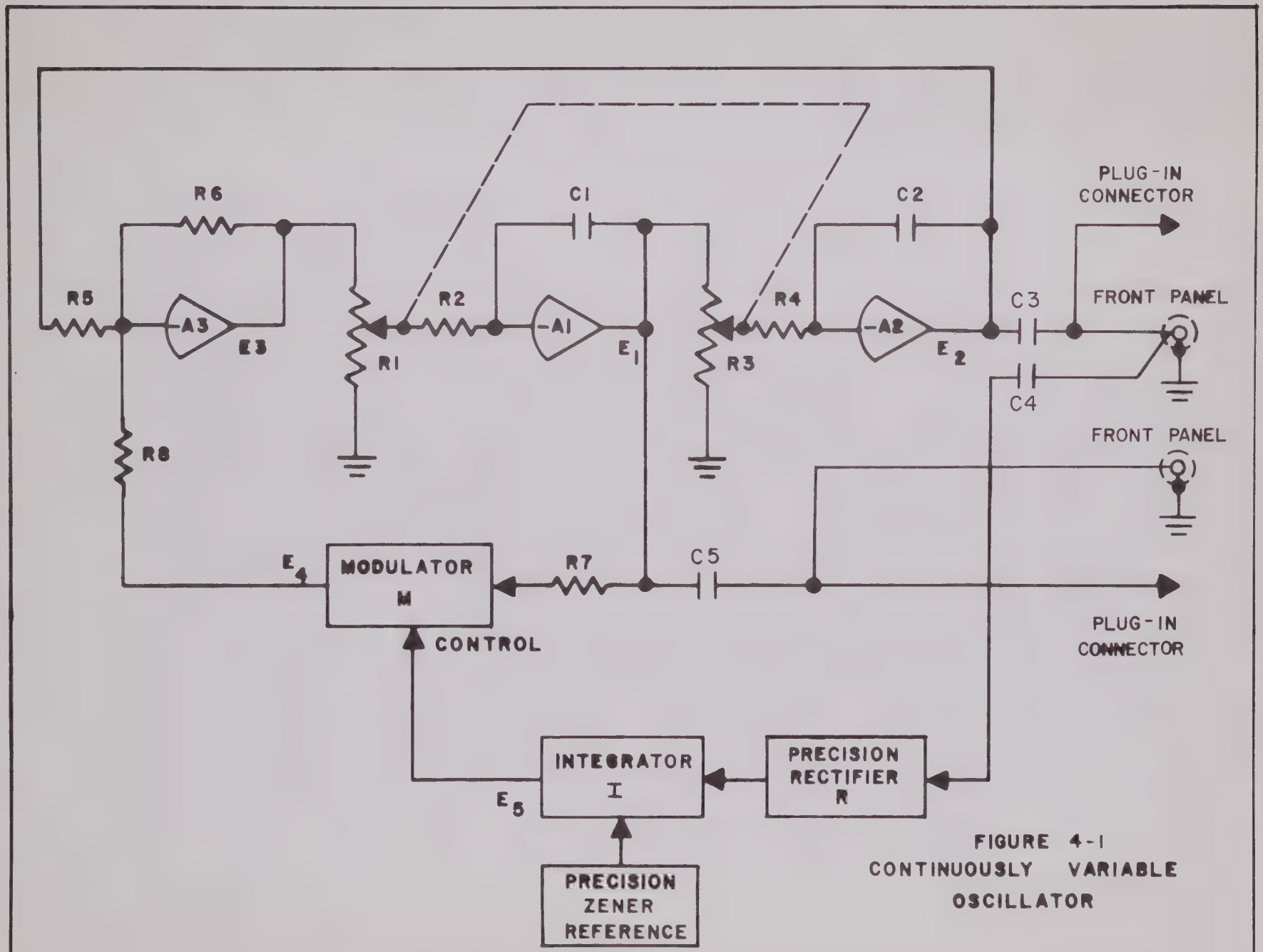


FIGURE 4-1
CONTINUOUSLY VARIABLE OSCILLATOR

SECTION 5

CALIBRATION

This section includes a complete calibration procedure for the Model 100 CVO oscillator. Adjustments need not be made in the sequence listed.

5.1. AUTOSHIFT MECHANISM ADJUSTMENT

a. Remove the autoshift connecting bar by removing the small E washer holding it to the sprocket and disc assembly. Tighten up on all parts of the connecting bar so as to minimize its length. Remount the connecting bar on the sprocket and disc assembly with the E washer.

b. Set main dial 1/8 inch from panel and tighten the set screw near "6" on the dial such that it bottoms on the flat of the main dial shaft. Wiggle the main dial when setting the screw against the flat.

c. With the range switch set for any range, adjust the connecting bar until a tooth on top of the sprocket is straight up and down. Overadjust the connecting bar until a click occurs at the bottom of the sprocket as the main dial is swung clockwise: This indicates an interference with the next sprocket tooth. Underadjust the connecting bar until a click occurs at the bottom of the sprocket. Set the adjustment on the connecting bar 1/2 way between the over and under positions and tighten it securely.

d. Go through the ranges and check that the disc pin does not hit a sprocket tooth before engaging the bottom tooth.

Adjust the length of the connecting bar as necessary in order to accomplish this requirement. In the clockwise direction, the autoshift should engage when the F on the dial is at the frequency marker. In the counterclockwise direction, the autoshift should engage when the U on the dial is at the frequency marker.

e. Set the main dial at 1 and rotate the range switch up and down the ranges. Set the main dial at 10 and repeat the rotation of the range switch. When rotating the range switch, the main dial must not move. If the dial moves, adjust the connecting bar as necessary and then repeat steps 5.1-d and 5.1-e.

5.2. FREQUENCY ADJUSTMENT

a. Adjust the main dial pot position such that the pot discontinuity occurs in the middle of the autoshift. This can be best accomplished by loosening the set screws holding the pot shaft and rotating the pot shaft until the discontinuity occurs: At this point set the main dial at 1. Tighten the set screws holding the pot shaft. Next use an open-end wrench to adjust the barrel of the pot until the discontinuity occurs at the middle of the autoshift.

b. Adjust the ±2% vernier pot such that at the 50% point of its rotation capability the vernier dial reads 0.

c. With a Weston PR840 RMS to DC converter or equivalent and an electronic counter, record ØA output when the main dial is set at 10 and the range switch is set at 100. Make sure that the ±2% vernier dial is at 0. Adjust the high frequency trims (R2 and R11 on the backboard) until the following simultaneously occur:

- Counter on ØA reads 1000 ±10Hz
- ØB output magnitude is the same as ØA ±1%

It will be found that the clockwise rotation of either R11 or R2 will cause the frequency to increase. However, it will also be found that the clockwise rotation of R11 causes ØB magnitude to decrease while the clockwise rotation of R2 causes ØB magnitude to increase. For this reason it will normally be necessary to adjust both R2 and R11 simultaneously for frequency after setting the magnitude.

d. Again with the RMS to DC converter or equivalent and a counter, record ØA output when the main dial is set at 1 and the range switch is set at 100. Adjust the low frequency trims (R3 and R7 on the backboard) until the following simultaneously occur:

    Counter on ØA reads 100 ±1 Hz

    ØB output magnitude is the same as ØA ±1%

    It will be found that the clockwise rotation of either R3 or R7 will cause the frequency to increase. However, it will also be found that the clockwise rotation of R7 causes ØB magnitude to decrease while the clockwise rotation of R3 causes ØB magnitude to increase.

e. Repeat steps 5.2.C. and 5.2.d. until both are simulatneously within their specified limits.

f. With the range switch set at 100 sweep the main dial from 1 to 10 and note the magnitude of ØB. It should remain constant within ±1% of the magnitude of ØA.

g. With the electronic counter, note the frequency when the main dial is set at 5 and the range switch is at 100. The frequency should be 500 ±5 Hz.

h. With the counter, record ØA output when the main dial is set at 10 and the range switch is set to 10 and then to 1K. The counter should read 100 ±1 Hz and 10,000 ±100Hz respectively.

i. With the RMS to DC converter and the counter, record ØA output when the main dial is set at 1 and the range switch is set at 10K. Adjust trim capacitors C15 on SW1-C board and SW1-D board until the following simultaneously occur:

Counter on ØA reads 10,000 ±200 Hz

ØB output magnitude is the same as ØA ±1%

It will be found that the clockwise rotation of C15 on either SW1-C or SW1-D will cause the frequency to decrease. However, it will also be found that the clockwise rotation of C15 on SW1-D causes ØB magnitude to decrease while the clockwise rotation of C15 on SW1-C causes ØB magnitude to increase.

j. Note the peak-to-peak magnitude of the signal on the test jack of the A4 board with an oscilloscope as the main dial is swept from 1 to 10 with the range switch set at 10K. Adjust the trim resistor R10 on SW1-D until the peak-to-peak magnitude never is greater than 500mV and never is less than 20mV.

k. With the RMS to DC converter and the counter, record ØA output when the main dial is set at 10 and the range switch is set at 10K. Adjust trim capacitors C15 and C15 on SW1-C board and SW1-D board until the following occur simultaneously:

Counter on ØA reads 100,000 ±2,000Hz

ØB output magnitude is the same as ØA ±5%

l. Repeat steps 5.2-i, 5.2-j, and 5.2-k until all are simultaneously within their specified limits.

5.3. AMPLITUDE ADJUSTMENT

With a thermal-transfer device (Weston 1573 or equivalent) on ØA set the main dial at 10 and the range switch at 100. Adjust the trim resistor R9 on the A4 board until the voltage magnitude is 12.110 volts ±.01%.

5.4. FREQUENCY RESPONSE ADJUSTMENT

A trim capacitor, C13 on the A4 board, was provided to adjust the high-frequency response of the oscillator, but it has not been required on most units. It is not anticipated that the frequency response should normally require readjustment during the life of the equipment. If the high-frequency response seems to be outside of specification limits, excessive control-voltage range is the most likely cause; repeat section 5.2.j. The only type of commercially-available equipment which is sufficiently accurate for these measurements to 100kHz is the Hermach type high-frequency, thermal-transfer standard (Englehard Industries - Part No. 34970-10C) or equivalent.

5.5. SETTLING TIME ADJUSTMENT

a. In order to maintain a reasonably constant low-level dc offset out of the A2 integrator as the frequency dial is rotated, a trim potentiometer R50 has been included on the A1 board. This maintains a constant dc into the main output coupling capacitors which reduces tuning transients and minimizes settling time.

b. Turn the CVO off and remove the A4 board. Attach a DC oscilloscope to the test jack on the A3 board (Pin E of the A3 board). Set main dial at 10 and range switch at 10K. Turn the CVO on and note the DC level as read on the oscilloscope. Using the 10 position of the dial as a reference, slowly rotate the dial to the 1 position. Adjust the trim potentiometer R50 on the A1 board until the maximum change of the DC does not exceed 10mV during the 10 to 1 sweep of the main dial.

c. Turn the CVO off and replace the A4 board. Turn the CVO on and check to insure that signals exist at the ØA and ØB connectors.

SECTION 6

CIRCUIT AND LOCATION DIAGRAMS

This section contains an overall block diagram and assembly location diagram, as well as detailed circuit and location diagrams necessary for maintenance of the Model 100 CVO.

The block diagram when used in conjunction with the Theory of Operation (Section 4), should aid in understanding circuit interrelationships.

Following is a list of the diagrams included in this section.

Number	Title
04-117-508	Block Diagram
04-117-164	Overall Location Diagram
04-117-503	Integrator A1
04-117-504	Integrator A2
04-117-505-1	Schematic, Amplitude Control Ckt A4
04-117-505-2	Location, Amplitude Control Ckt A4
04-117-506	Power Supply "A" and "B"
04-117-507	Amplifier A3
04-117-512	Guard Driver

FRONT PANEL OUTPUTS

INTEGRATOR (A1) SCH 04-117-509

INTEGRATOR (A2) SCH 04-117-504

AMPL. (A-3) SCH 04-117-507

SW-1D BOARD

SW-1C BOARD

TB2 BOARD
FOR 9 DIAL COUPLED POT OPTION 06

REAR OUTPUT CONNECTOR J1

EXT MOD
HI (INSPECTIONAL TC FREQUENCY (OPTION 04))
LO
10-100 HZ
100-1000 HZ
1-10 KHZ
0.1-100 KHZ
RANGE SW
ARM
ATTEN
ATTEN GND BA
BB ATTEN
ATTEN GND BB
OUT
GND
+36 V
-36 V
PS GND
BA SIG GND IN
BB SIG GND IN
BA IN
BB IN
FRAME GND

OPTION 07
AMPLIFIER (GUARD DRIVER) SCH 04-117-518

REAR PANEL CONN J3

PLUG-IN CONNECTOR J6

POWER SUPPLY A SCH 04-117-505

POWER SUPPLY A SCH 04-117-506

WESTON 04-117-090

WESTON 14 117 097

AMPLITUDE CONTROL CIRCUIT (A6) SCH 04-117-505

OPTION 05

REAR PANEL EXT. SYNC OPTION 08

EXT. MOD.

FRONT PANEL S3 DS1

REAR PANEL J7

T1

FACTORY ADJUSTMENT
MODIFICATIONS TO POWER INPUT CIRCUIT FOR 230 VOLT OPERATION

SW-1B BOARD

SW-1A BOARD

FLATNESS ADJUST OPTION 08

X10
X100
ARM X1K
X10K
X10
X100
ARM X1K
X10K

SW1

LOCATION, SW-1B BOARD
(NOTE: R5 & R6 NOT LOCATED ON 100 SERIES - SHOWN ONLY ON 100 A SERIES)

LOCATION SW-1C BOARD

LOCATION, SW-1D BOARD

LOCATION, SW-1E BOARD

IDENTIFICATION CHART
SW1 (MULTIPLIER) POSITIONS

POSITION	1	2	3	4	5	6	7	8	9	10	11
PINS	1,2	3,4	5,6	7,8	9,10	11,12	13,14	15,16	17,18	19,20	21,22

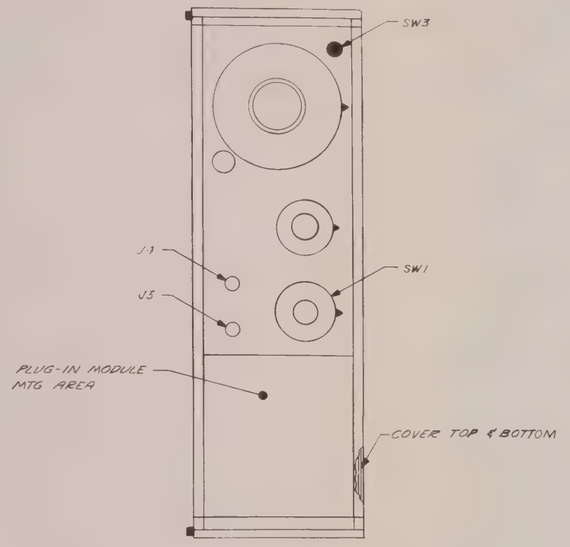
NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   A. RESISTOR VALUES ARE IN OHMS.
   B. CAPACITOR VALUES ARE IN MF.
2. SYMBOL IDENTIFICATION
   A ⊙ = INDICATES ADDITIONAL 50 PINS
   B ⊙ = INDICATES MORE THAN 50 PINS
   C = CONNECTIONS
   C □ = INDICATES CONNECTOR HAS AT LEAST 3 PINS
   D. ⊙ = INDICATES TB1A

WESTON-ROTEK

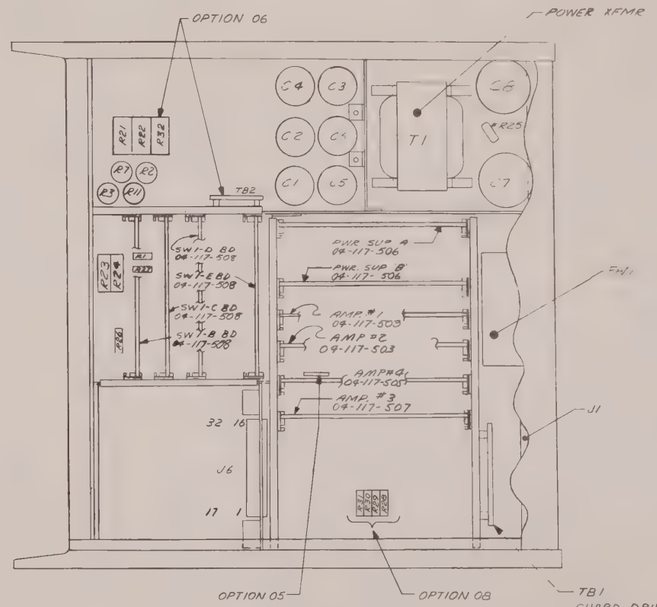
BLOCK DIAGRAM SCH

04-117-500

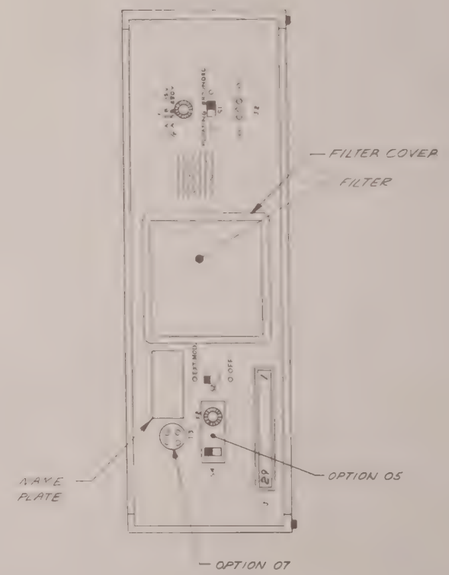
FRONT VIEW



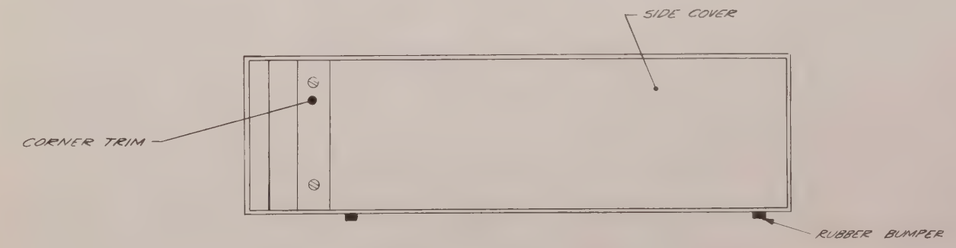
TOP VIEW



REAR VIEW



VI-117-169



RIGHT SIDE VIEW

08	FLATNESS	R's 28, 29, 30, 31
07	GUARD DRIVER	TB1, J3
06	REAR PANEL DC PROPORTIONAL TO DIAL	TB2, R32
05	EXTERNAL SYNC	S4, F2, A-4 EXT SYNC
NO.	TYPE	COMPONENT PARTS
OPTIONS		

WESTON-ROTEK

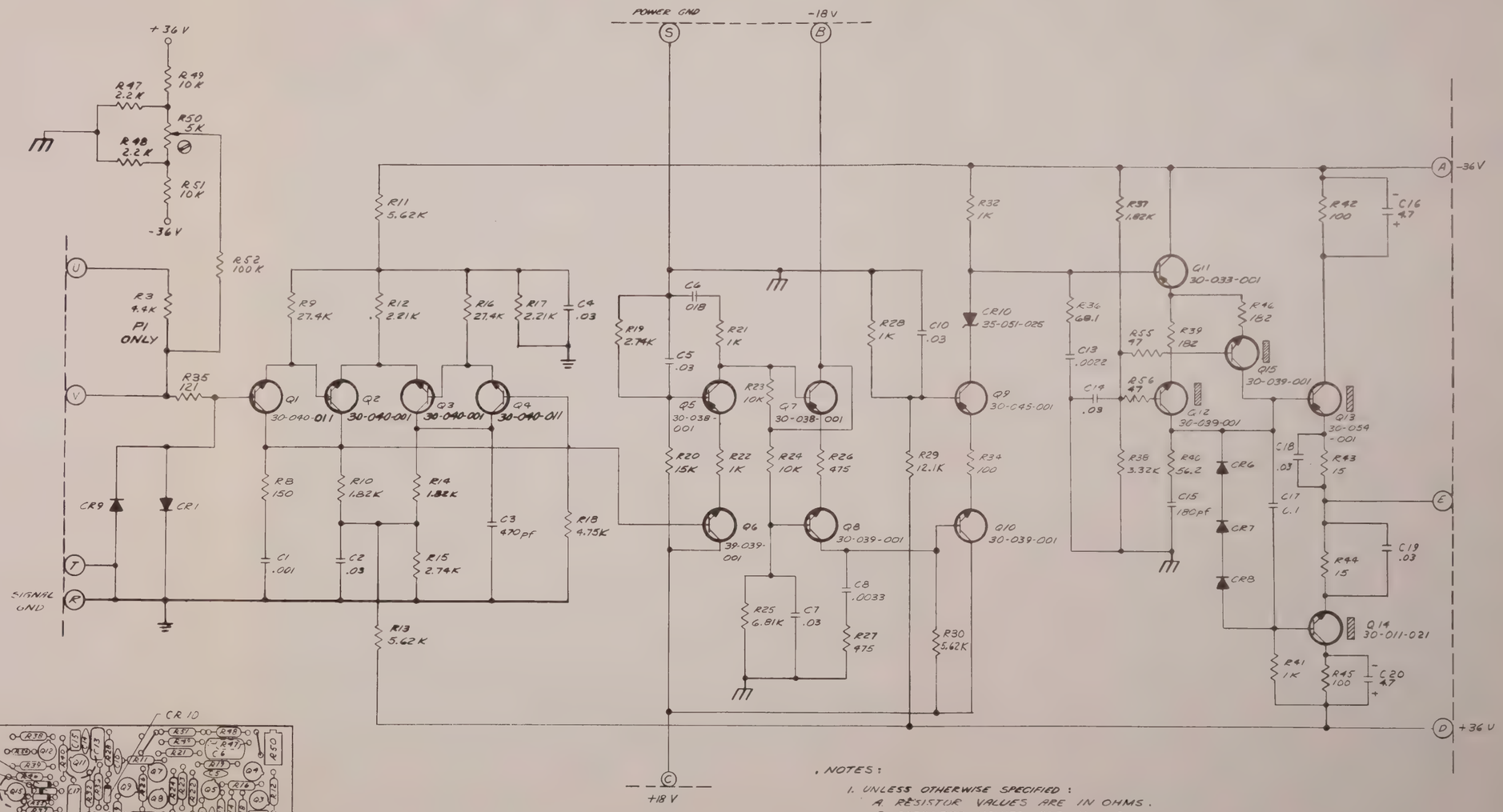
Scale 1-2 Date 3-3-67 Dwg 1-117-849

Dr. ART KUNTER Date 7/18/67

Check Project 700

LOCATION, CVO

Size D Drawing No 11-117-169 Sheet 1 of 1 Rev



P1 - 100 (CVO)
101 (CVS)

P2 - 102 (DVO)
103 (DVS)

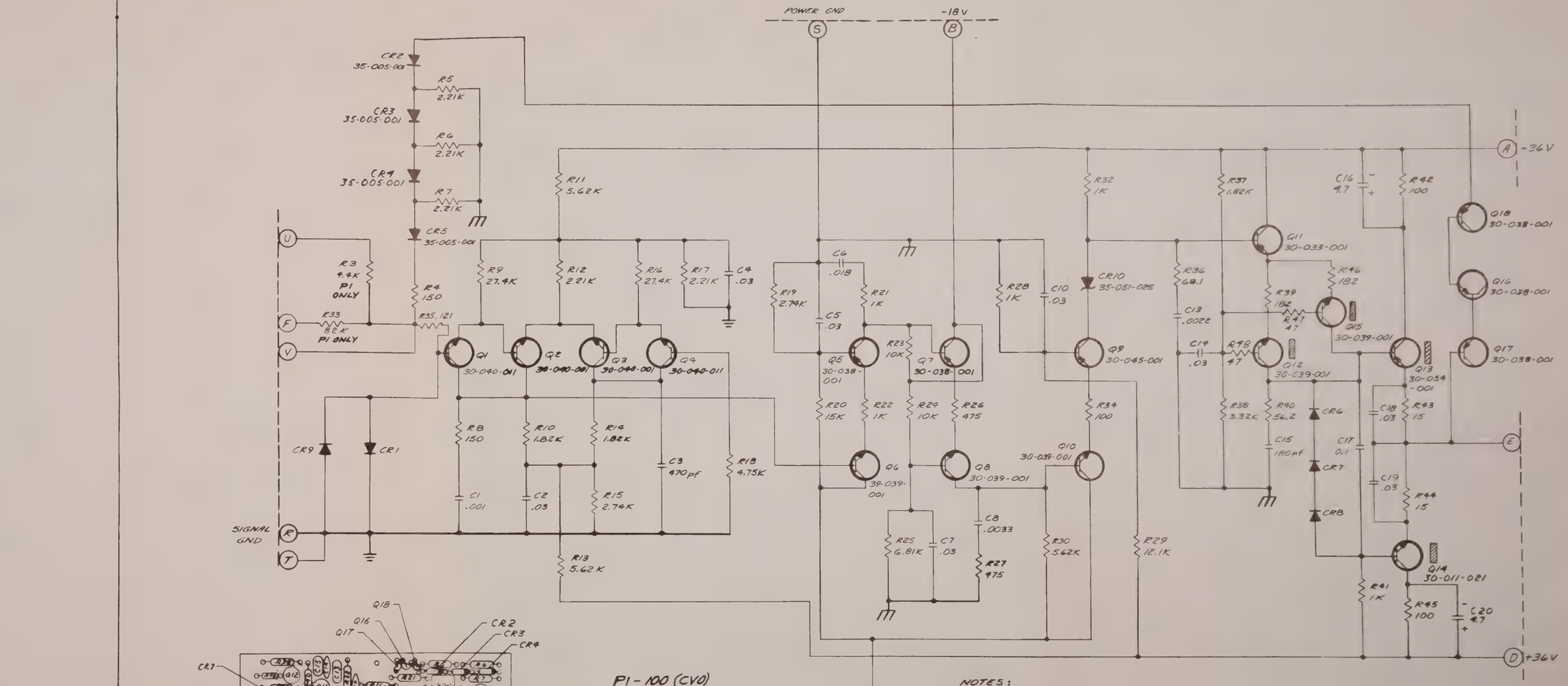
NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   A. RESISTOR VALUES ARE IN OHMS.
   B. CAPACITOR VALUES ARE IN μf.
   C. DIODES ARE 35-001-004.
2. CAUTION
   HEAT SINK ON Q13 & 14 ABSOLUTELY ESSENTIAL TO PREVENT OVER DISSIPATION OF TRANSISTOR.

WESTON-ROTEK

SCH, INTEGRATOR (A1)

D Q1-112-503



P1 - 100 (CVO)
101 (CVS)

P2 - 102 (DVO)
103 (DVS)

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   A. RESISTOR VALUES ARE IN OHMS.
   B. CAPACITOR VALUES ARE IN mf.
   C. DIODES ARE 35-001-001.

WESTON-ROTEX

SCH. INTEGRATOR (A2)

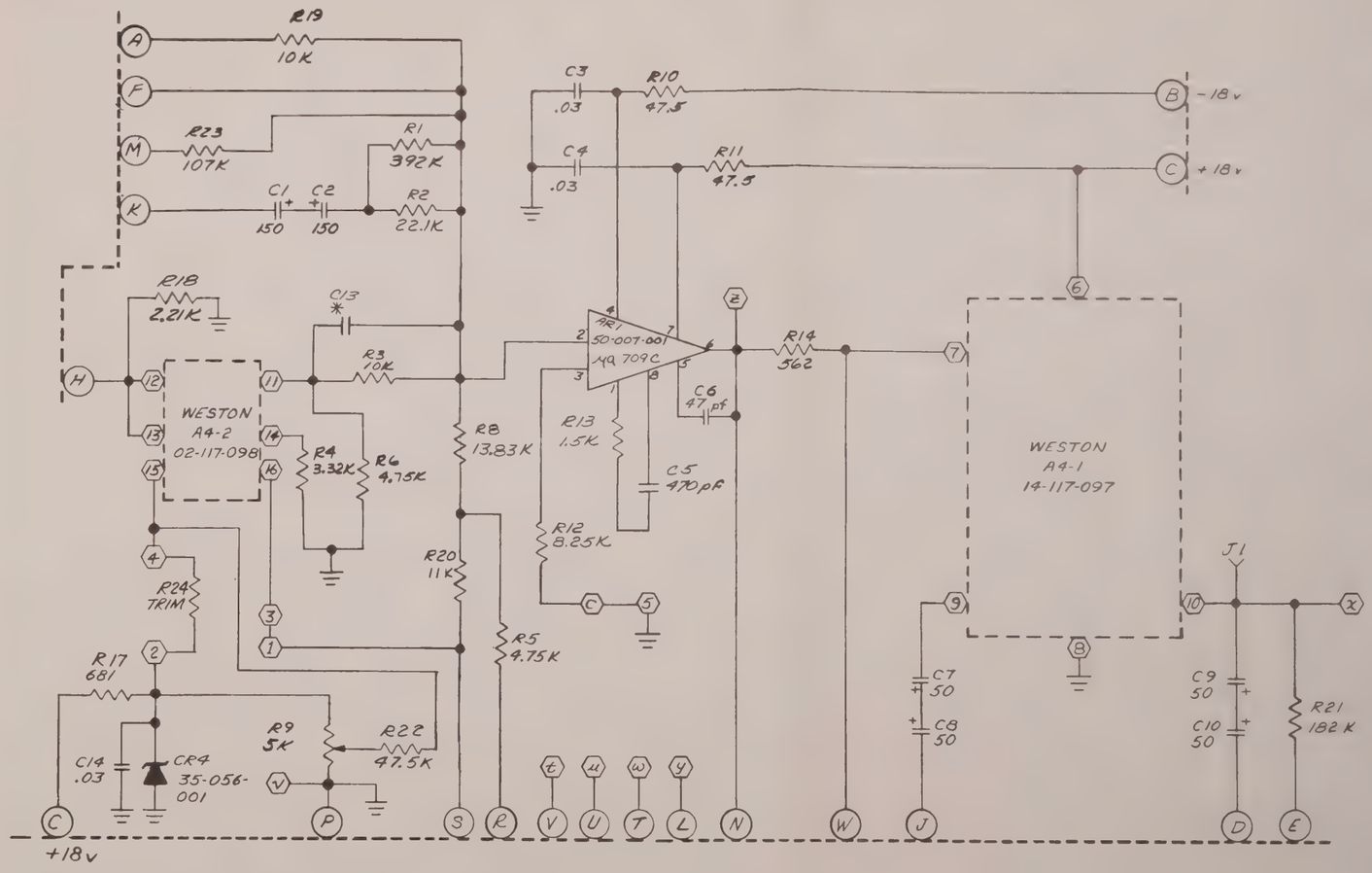
Project CVO

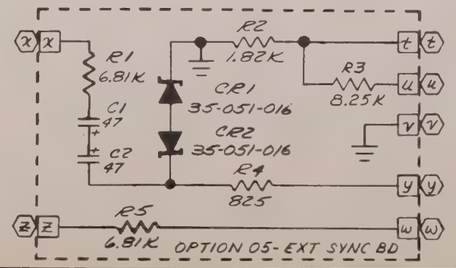
D 04-117-504 1 of 1 E

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a- RESISTOR VALUES ARE IN OHMS.
   b- CAPACITOR VALUES ARE IN μf.
2. * - TRIM COMPONENT

NORMAL OPERATION:
JUMP: 1 → 3
2 → 4
5 → C

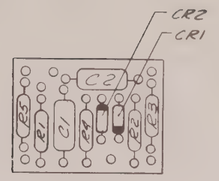




04-117-505

WESTON-ROTEK WESTON INSTRUMENTS, INC.

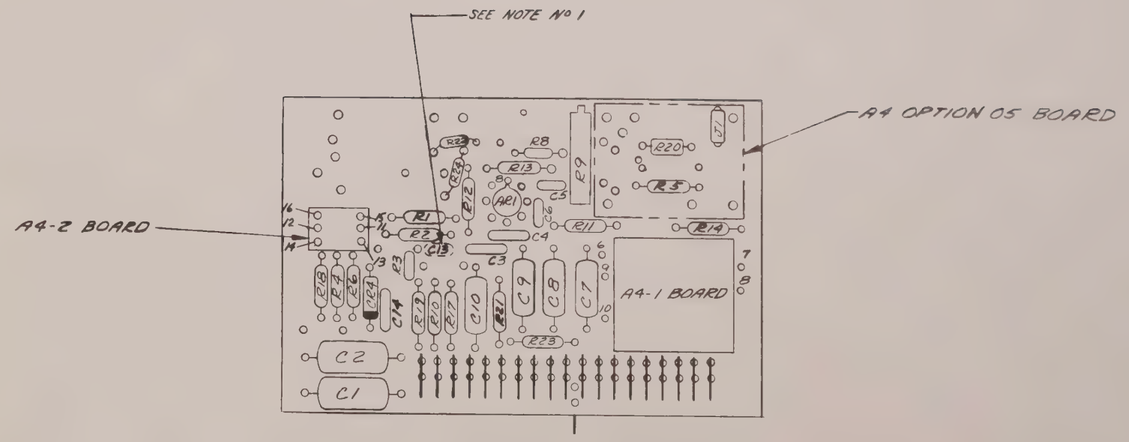
Used On		Scale ~	Date 9-20-67
83-117-03A		Drawn K. PATTERSON	App. — 9/6/67
83-117-077		Checked ROGERS	Proj. Eng. CVO
		SCHEMATIC, AMPLITUDE CONTROL CKT, A4	
		Size C	Drawing No. 04-117-505
		Sheet 1 of 2	Rev. D



LOCATION
A4 OPTION 05 BOARD

NOTES:

1. C13 IF REQUIRED, TO BE TRIMMED AT TEST.

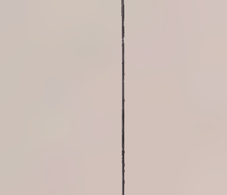


04-117-505

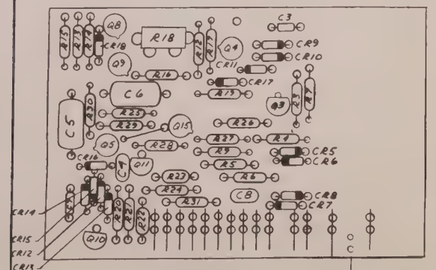
WESTON—ROTEK (WESTON INSTRUMENTS INC)				
Used On		Scale 1-1	Date 7/1967	Eng CJT 7/16/67
23-117-030		Dr RON SIERGIEJ		Apv 7/14/67
23-117-271		Ch'd A. ROGERS		Proj 100
		SCHEMATIC, AMPLITUDE CONTROL CKT. A4		
		Size C	Drawing No 04-117-505	Sheet 2 of 2	Rev D

POWER SUPPLY 'A'

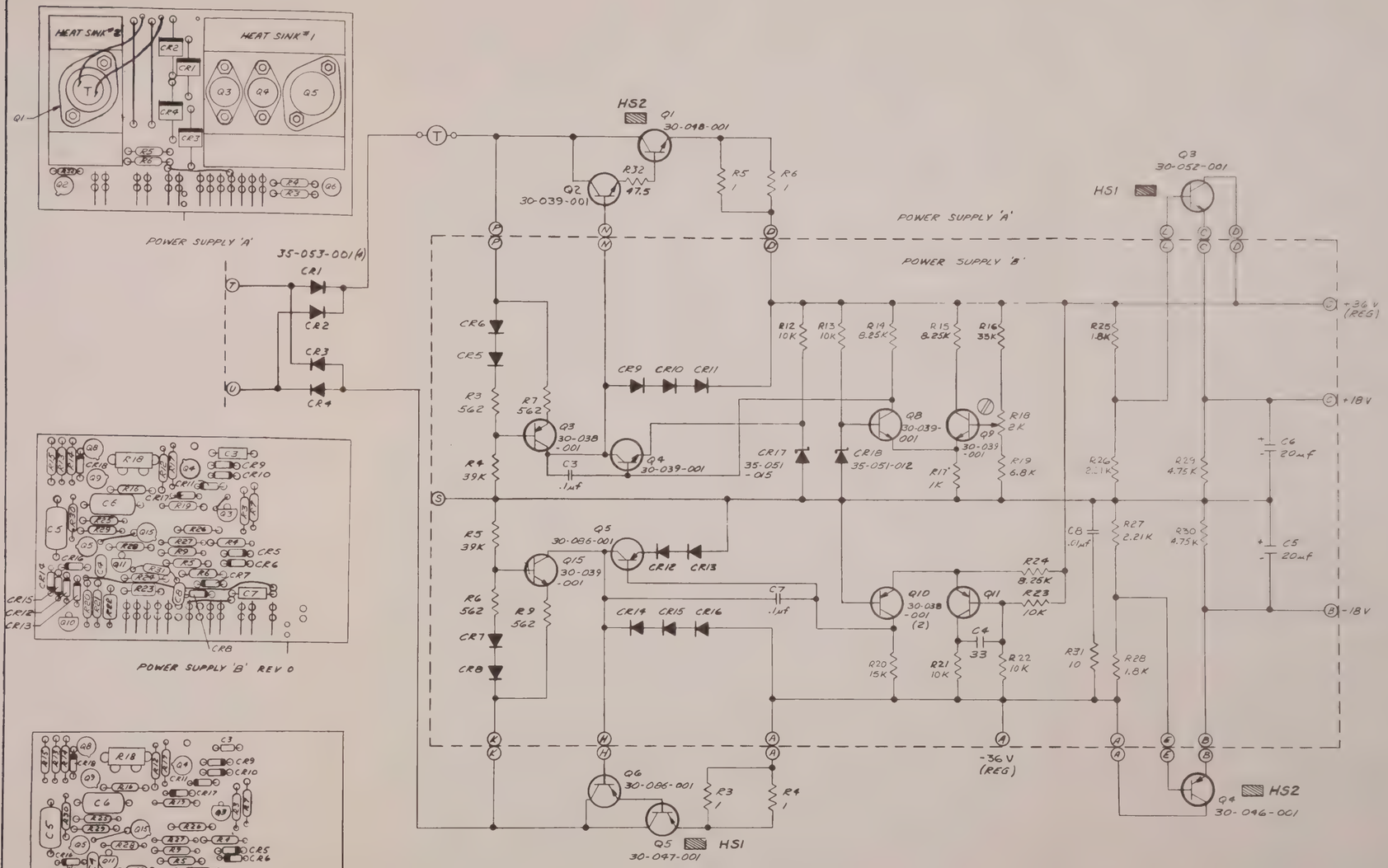
35-053-001(A)



POWER SUPPLY 'B' REV D



POWER SUPPLY 'B' REV C



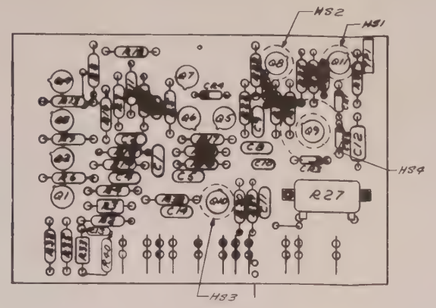
NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   A. RESISTOR VALUES ARE IN OHMS.
   B. CAPACITOR VALUES ARE IN pf.
   C. DIODES ARE 35-001-001.

Rev	E.C.O.	Revisions	By	Date	Check

WESTON—ROTEK — WESTON INSTRUMENTS INC.

Dwg No		Scale ~	Date 9-20-66
		Dr FEE	
		Chkd ROGERS	
		SCHEMATIC, REG. POWER SUPPLY A'+B'	
		Size D	Drawing No 04-117-506
		Sheet 1 of 1	Rev D



A3 BOARD, REV D

POWER GND

- 36 VOLTS

+ 36 VOLTS

+18 VOLTS

SIGNAL GND

TP1

R1 3.32K
R2 10K
R3 10K
R4 3.32K
R5 150
R6 27.4K
R7 1.82K
R8 5.62K
R9 2.21K
R10 5.62K
R11 1.82K
R12 2.74K
R13 27.4K
R14 2.21K
R15 1.82K
R16 1K
R17 12.1K
R18 1K
R20 100
R22 68.1
R23 1.82K
R24 100
R25 182
R26 56.2
R27 1K
R29 15
R30 15
R32 8.25K
R33 10K
R34 182
R35 221K
R36 47
R37 47
R38 100
R40 3.9K

C1 1000pf
C2 .03
C3 470pf
C4 .03
C5 .03
C8 2200 pf
C9 .03
C10 180pf
C11 .03
C12 0.1
C13 10pf
C14 .03

CR1
CR2
CR3
CR4 35-051-025

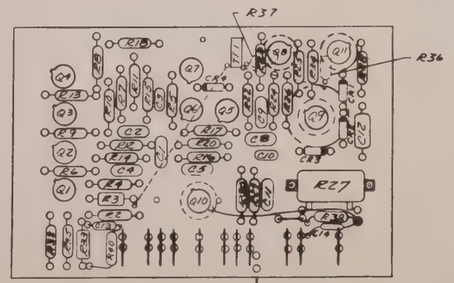
Q1 30-040-011
Q2 30-040-001
Q3 30-040-001
Q4 30-040-011
Q5 30-038-001
Q6 30-039-001
Q7 30-033-001
Q8 30-039-001
Q9 30-054-001
Q10 30-018-021
Q11 30-039-001

HS1
HS2
HS3
HS4

NOTES:

UNLESS OTHERWISE SPECIFIED:

A. RESISTOR VALUES ARE IN OHMS.
B. CAPACITOR VALUES ARE IN μf.
C. DIODES ARE 35-001-001.



A3 BOARD, REV A

		RNK 9-20-67	APP'D 2/7/68	
		RNK	9/6/67	
		ROGERS	CVO	
		SCH, AMPLIFIER (A3)		
D	04-117-509			D

SECTION 7

REPLACEABLE PARTS

This section contains ordering information for replacement parts listed by assembly. If the value of a component is determined at final test (designated by *), only the manufacturer is given. Where manufacturer and type are not given (designated by **), parts may be ordered directly from Weston-Lexington. These parts should be identified by Weston-Lexington part number; the instrument model number and serial number should also be specified.

Following is a list of assemblies included in this section

Name	Schematic Number	Page
Frame Assembly	07-117-508	7-2
Integrator Board A1	04-117-503	7-3
Integrator Board A2	04-117-504	7-5
A4 Board	04-117-505	7-7
Power Supply "A"	04-117-506	7-8
Power Supply "B"	04-117-506	7-9
Amplifier A3	04-117-507	7-10
SW1-B Board	04-117-508	7-12
SW1-C Board	04-117-508	7-13
SW1-D Board	04-117-508	7-14
SW1-E Board	04-117-508	7-15
Backboard	04-117-508	7-16
Options	-	7-17

FRAME ASSEMBLY 07-117-508

REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
	REAR PANEL SUBASSEMBLY			
B1	Fan, Muffin Venturi	26-006-001	Rotron	--
F1	Fuse, 1ASB 115V, 1/2ASB 230V	33-010-007	Buss	MDL
XF1	Fuse Holder	33-002-001	Buss	HKP
SW1 & 2	Switch, Slide, SPST	34-062-001	H.H.Smith	515
J2	Receptacle, 3 Pin, 15A/725V	29-052-001	Tower	1061-1
J7	Conn. 3 Pin, Female, Line outlet	29-046-001	Amphenol	160-2
	FRAME SUBASSEMBLY			
R21,22	Resistor, Variable, Dual 1K, 150mW	40-412-002	**	--
R23,24	Resistor, Variable, Dual 50K, 2W	40-414-001	Allen-Bradley	JJ
T1	Power Transformer	27-346-001	**	--
DS1	Lamp, Neon	37-007-001	G.E.	A1H
SW3	Switch-Indicator, SPST	34-056-001	Marco-Oak	SW616-26
J4,J5	Connector, BNC Receptacle	29-057-001	Amphenol	31-105

INTEGRATOR BOARD (A1) 04-117-503

REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
R43,44	Resistor, Film, 15Ω, 1W, 1%	40-002-007	IRC	CEC
R40	Resistor, Film, 56.2Ω, 1W, 1%	40-002-021	IRC	CEC
R36	Resistor, Film, 68.1Ω, 1W, 1%	40-002-023	IRC	CEC
R42,45	Resistor, Wirewound, 100Ω, 10W, 5%	40-203-031	Hardwick-Hindle	3/4 BRS-56
R35	Resistor, Film, 121Ω, 1W, 1%	40-002-029	IRC	CEC
R8	Resistor, Film, 150Ω, 1W, 1%	40-002-031	IRC	CEC
R39,46	Resistor, Film, 182Ω, 1W, 1%	40-002-033	IRC	CEC
R26,27	Resistor, Film, 475Ω, 1W, 1%	40-002-043	IRC	CEC
R21,22,28,32	Resistor, Film, 1K, 1W, 1%	40-002-053	IRC	CEC
R10,14,37	Resistor, Film, 1.82K, 1W, 1%	40-002-059	IRC	CEC
R12,17,47,48	Resistor, Film, 2.21K, 1W, 1%	40-002-063	IRC	CEC
R15,19	Resistor, Film, 2.74K, 1W, 1%	40-002-065	IRC	CEC
R38	Resistor, Film, 3.32K, 1W, 1%	40-002-067	IRC	CEC
R18	Resistor, Film, 4.75K, 1W, 1%	40-002-071	IRC	CEC
R11,13,30	Resistor, Film, 5.62K, 1W, 1%	40-002-073	IRC	CEC
R25	Resistor, Film, 6.81K, 1W, 1%	40-002-075	IRC	CEC
R23,24,49,51	Resistor, Film, 10K, 1W, 1%	40-002-079	IRC	CEC
R29	Resistor, Film, 12.1K, 1W, 1%	40-002-081	IRC	CEC
R20	Resistor, Film, 15K, 1W, 1%	40-002-083	IRC	CEC
R9,16	Resistor, Film, 27.4K, 1W, 1%	40-002-089	IRC	CEC
R50	Resistor, Variable, 5K	40-418-009	Helipot	77P
R41	Resistor, Power, 1K, 15W, 5%	40-221-001	Hardwick-Hindle	BRS
R3	Resistor, W-W, 4.4K, .33W, 0.1%, 7ppm/°C	40-187-001	Daven	1301
R55,56	Resistor, Film, 47Ω, 1/4W, 10%	40-012-012	Allen-Bradley	CB
R34	Resistor, Film, 100Ω, 1W, 1%	40-002-027	IRC	CEC
R52	Resistor, Film, 100K, 1W, 1%	40-002-103	IRC	CEC
C2,4,5,7,10,14,18,19	Capacitor, Ceramic, .03μf, 50V, +80% -20%	45-902-002	Centralab	CK-303
C15	Capacitor, Mica, 180pf, 300V, 3%	45-003-013	Electro-Motive	DM 15F
C3	Capacitor, Mica, 470pf, 300V, 3%	45-003-023	Electro-Motive	DM 15F
C1	Capacitor, Mica, 1000pf, 300V, 3%	45-004-001	Electro-Motive	DM 19F
C13	Capacitor, Mica, 2200pf, 300V, 3%	45-004-009	Electro-Motive	DM 19F
C8	Capacitor, Mica, 3300pf, 300V, 3%	45-004-013	Electro-Motive	DM 19F

INTEGRATOR BOARD (A1) 04-117-503 CONTINUED

REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
C6	Capacitor, Mica, 18000pf, 100V, 2%	45-008-002	Electro-Motive	DM 20E
C17	Capacitor, Mylar, 0.1μf, 200V, 10%	45-108-501	Sprague	192P
C16,20	Capacitor, Tantalum, 4.7μf, 50V, 20%	45-412-001	Sprague	150D
CR1,6-9	Diode, Silicon, 200mA, 120PIV	35-001-001	Fairchild	1N658
CR10	Diode, Silicon Reference, 24V, 400mW	35-051-025	Motorola	MZ-500-25
Q11	Transistor, PNP Silicon	30-033-001	**	--
Q5,7	Transistor, PNP Silicon	30-038-001	**	2N3906
Q6,8,10,12,15	Transistor, NPN Silicon	30-039-001	Sprague	TN53
Q1-4	Transistor, NPN Silicon	30-040-011	**	--
Q9	Transistor, PNP Silicon	30-045-001	Fairchild	2N3645
Q13	Transistor, PNP Silicon	30-054-001	**	--
Q14	Transistor, NPN Silicon	30-011-021	**	--
HS1,2,3,4	Heat Sink, Top Hat, JEDEC Type TO-5	55-003-001	Wakefield Eng.	207

INTEGRATOR BOARD (A2) 04-117-504

REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
R43,44	Resistor, Film, 15Ω, 1W, 1%	40-002-007	IRC	CEC
R40	Resistor, Film, 56.2Ω, 1W, 1%	40-002-021	IRC	CEC
R36	Resistor, Film, 68.1Ω, 1W, 1%	40-002-023	IRC	CEC
R34	Resistor, Film, 100Ω, 1W, 1%	40-002-027	IRC	CEC
R35	Resistor, Film, 121Ω, 1W, 1%	40-002-029	IRC	CEC
R4,8	Resistor, Film, 150Ω, 1W, 1%	40-002-031	IRC	CEC
R39,46	Resistor, Film, 182Ω, 1W, 1%	40-002-033	IRC	CEC
R26,27	Resistor, Film, 475Ω, 1W, 1%	40-002-043	IRC	CEC
R21,22,28,32	Resistor, Film, 1K, 1W, 1%	40-002-053	IRC	CEC
R10,14,37	Resistor, Film, 1.82K, 1W, 1%	40-002-059	IRC	CEC
R5-7,12,17	Resistor, Film, 2.21K, 1W, 1%	40-002-063	IRC	CEC
R15,19	Resistor, Film, 2.74K, 1W, 1%	40-002-065	IRC	CEC
R38	Resistor, Film, 3.32K, 1W, 1%	40-002-067	IRC	CEC
R18	Resistor, Film, 4.75K, 1W, 1%	40-002-071	IRC	CEC
R11,13,30	Resistor, Film, 5.62K, 1W, 1%	40-002-073	IRC	CEC
R25	Resistor, Film, 6.81K, 1W, 1%	40-002-075	IRC	CEC
R23,24	Resistor, Film, 10K, 1W, 1%	40-002-079	IRC	CEC
R29	Resistor, Film, 12.1K, 1W, 1%	40-002-081	IRC	CEC
R20	Resistor, Film, 15K, 1W, 1%	40-002-083	IRC	CEC
R9,16	Resistor, Film, 27.3K, 1W, 1%	40-002-089	IRC	CEC
R33	Resistor, Film, 82.5K, 1W, 1%	40-002-101	IRC	CEC
R41	Resistor, Power, 1K, 15W, 5%	40-221-001	Hardwick-Hindle	BRS
R3	Resistor, Metal Film, 4.4K, .3W, 0.1%, 7ppm/°C	40-006-002	Vishay	S102
R42,45	Resistor, Power, 100Ω, 10W, 5%	40-203-031	Hardwick-Hindle	BRS
R47,48	Resistor, Film, 47Ω, 1/4W, 1%	40-012-012	Allen-Bradley	CB
C2,4,5,7,10,14,18,19	Capacitor, Ceramic, .03μf, 50V, +80% -20%	45-902-002	Centralab	CK-303
C15	Capacitor, Mica, 180pf, 300V, 3%	45-003-013	Electro-Motive	DM 15F
C3	Capacitor, Mica, 470pf, 300V, 3%	45-003-023	Electro-Motive	DM 15F
C1	Capacitor, Mica, 1000pf, 300V, 3%	45-004-001	Electro-Motive	DM 19F

INTEGRATOR BOARD (A2) 04-117-504 CONTINUED

REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
C13	Capacitor, Mica, 2200pf, 300V, 3%	45-004-009	Electro-Motive	DM 19F
C8	Capacitor, Mica, 3300pf, 300V, 3%	45-004-013	Electro-Motive	DM 19F
C6	Capacitor, Mica, .018μf, 100V, 2%	45-008-002	Electro-Motive	DM 20E
C17	Capacitor, Mylar, 0.1μf, 200V, 10%	45-108-501	Sprague	192P
C16,20	Capacitor, Tantalum, 4.7μf, 50V, 20%	45-412-001	Sprague	150D
CR1,6-9	Diode, Silicon, 200mA, 120 PIV	35-001-001	Fairchild	1N658
CR2-5	Diode, Silicon, 75mA, 50 PIV	35-005-001	Fairchild	FD100
CR10	Diode, Silicon Reference, 24V, 400mW	35-051-025	Motorola	MZ500
Q11	Transistor, PNP Silicon	30-033-001	Motorola	2N1132
Q5,7,16-18	Transistor, PNP Silicon	30-038-001	Motorola	2N3906
Q6,8,10,12,15	Transistor, NPN Silicon	30-039-001	Sprague	TN53
Q1-4	Transistor, NPN Silicon	30-040-011	**	--
Q9	Transistor, PNP Silicon	30-045-001	Fairchild	2N3645
Q13	Transistor, PNP Silicon	30-054-001	Motorola	2N3634
Q14	Transistor, NPN Silicon	30-011-021	**	--
HS1,2,3,4	Heat Sink, Top Hat, JEDEC Type TO-5	55-003-001	Wakefield Eng.	207

A4 BOARD 04-117-505

REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
R10,11	Resistor, Film, 47.5Ω, 1W, 1%	40-002-019	IRC	CEC
R14	Resistor, Film, 562Ω, 1W, 1%	40-002-045	IRC	CEC
R17	Resistor, Film, 681Ω, 1W, 1%	40-002-049	IRC	CEC
R13	Resistor, Film, 1.5K, 1W, 1%	40-002-057	IRC	CEC
R18	Resistor, Film, 2.21K, 1W, 1%	40-002-063	IRC	CEC
R4	Resistor, Film, 3.32K, 1W, 1%	40-002-067	IRC	CEC
R5,6	Resistor, Film, 4.75K, 1W, 1%	40-002-071	IRC	CEC
R12	Resistor, Film, 8.25K, 1W, 1%	40-002-077	IRC	CEC
R3	Resistor, Film, 10K, 0.3W, 0.1%5ppm/°C	40-006-001	Vishay	S102
R2	Resistor, Film, 22.1K, 1W, 1%	40-002-087	IRC	CEC
R21	Resistor, Film, 182K, 1W, 1%	40-002-109	IRC	CEC
R23	Resistor, WW, 107K, 1/4W, 0.1%	40-103-302	Daven	1274
R1	Resistor, Film, 392K, 1W, 1%	40-002-117	IRC	CEC
R22	Resistor, Film, 47.5K, 1W, 1%	40-002-095	IRC	CEC
R20	Resistor, WW, 11K, 1/4W, 0.1% 7ppm/°C	40-176-204	Daven	1250
R9	Resistor, Variable, 5K, .75W, 10T	40-409-009	Helipot	75PR
R19	Resistor, Film, 10K, 1W, 1% ±100ppm/°C	40-002-079	IRC	CEC
R8	Resistor, WW, 13.83K, 1/4W, 0.1%	40-103-069	Daven	1274
C7,8,9,10	Capacitor, Aluminum, 50μf, 15V	45-215-053	Sprague	30D
C1,2	Capacitor, Aluminum, 150μf, 15V	45-215-052	Sprague	30D
C3,4,14	Capacitor, Ceramic, .03μf, 50V, +80% -20%	45-902-002	Centralab	CK-303
C13	Capacitor, Mica, Trim, 300V, ±.5pf	*	Electro-Motive	--
C6	Capacitor, Mica, 47pf, 300V, 3%	45-002-005	Electro-Motive	DM 15E
C5	Capacitor, Mica, 470pf, 300V, 3%	45-003-023	Electro-Motive	DM 15F
CR4	Diode, Silicon Reference, 11.7V, 750mW 5%	35-056-001	Motorola	1N3581
AR1	Amplifier, Integrated Circuit	50-007-001	Fairchild	μA709C

A4 BOARD 04-117-505 CONTINUED

REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
A4-1	Assembly Potted	02-117-097	Weston	--
A4-2	Assembly Potted	02-117-098	Weston	--
R24	Resistor, Trim	*		
TP1	Test Jack, P.C. Red	29-024-001	H.H.Smith	430-102

POWER SUPPLY A 04-117-506

REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
R3-6	Resistor, Power, 1Ω, 3W, 5%	40-219-001	Ward-Leonard	3X
R1,2	Resistor, Power, 5Ω, 10W, 5%	40-220-001	Ward-Leonard	10XM
CR1-4	Diode, Silicon Rectifier, 3A, 200 PIV	35-053-001	Motorola	MR2071
Q2	Transistor, NPN Silicon	30-039-001	Sprague	TN53
Q6	Transistor, PNP Silicon	30-086-001	RCA	2N4314
Q4	Transistor, PNP Silicon	30-046-001	Motorola	MJ2253
Q5	Transistor, PNP Silicon	30-047-001	Motorola	MJ2268
Q1	Transistor, NPN Silicon	30-048-001	Motorola	MJ2256
Q3	Transistor, NPN Silicon	30-052-001	Motorola	MJ2249
R32	Resistor, Film, 47.5Ω, 1W, 1%	40-002-019	IRC	CEC
SW1	Thermostat, Open 195° F: Close 155° F	41-005-003	Klixon - T.I.	20700L
HS1	Heat Sink	10-117-080	Weston	--
HS2	Heat Sink	10-117-081	Weston	--

POWER SUPPLY B 04-117-506

REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
R3,6,7,9	Resistor, Film, 562Ω, 1W, 1%	40-002-045	IRC	CEC
R17	Resistor, Film, 1K, 1W, 1%	40-002-053	IRC	CEC
R25,28	Resistor, Film, 1.82K, 1W, 1%	40-002-059	IRC	CEC
R26,27	Resistor, Film, 2.21K, 1W, 1%	40-002-063	IRC	CEC
R29,30	Resistor, Film, 4.75K, 1W, 1%	40-002-071	IRC	CEC
R19	Resistor, Film, 6.81K, 1W, 1%	40-002-075	IRC	CEC
R14,15,24	Resistor, Film, 8.25K, 1W, 1%	40-002-077	IRC	CEC
R12,13,21	Resistor, Film, 10K, 1W, 1%	40-002-079	IRC	CEC
R20	Resistor, Film, 15K, 1W, 1%	40-002-083	IRC	CEC
R16	Resistor, Film, 33.2K, 1W, 1%	40-002-091	IRC	CEC
R4,5	Resistor, Film, 39.2K, 1W, 1%	40-002-093	IRC	CEC
R18	Resistor, Variable, 2K, 2W	40-413-004	Clarostat	39
R22,23	Resistor, W-W, 10K, 1/4W, 0.1% 7ppm/°C	40-176-200	Daven	1250
R31	Resistor, Film, 10Ω, 1W, 1%	40-002-003	IRC	CEC
C5,6	Capacitor, Aluminum, 20μf, 50V	45-214-004	Sprague	30D
C4	Capacitor, Mica, 33pf, 300V, 3%	45-002-003	Electro-Motive	DM 15E
C3,7	Capacitor, Mylar, .1μf, 100V, 10%	45-102-004	Electro-Motive	DM 15F
C8	Capacitor, Mylar, .01μf, 100V, 10%	45-101-003	Electro-Motive	P710311
CR5-16	Diode, Silicon, 200mA, 120 PIV	35-001-001	Fairchild	1N658
CR18	Diode, Silicon Reference, 6.8V, 400mW	35-051-012	Motorola	MZ500
CR17	Diode, Silicon Reference, 9.1V, 400mW	35-051-015	Motorola	MZ500
Q3,10,11	Transistor, PNP Silicon	30-038-001	Motorola	2N3906
Q4,8,9,15	Transistor, NPN Silicon	30-039-001	Sprague	TN53
Q5	Transistor, PNP Silicon	30-086-001	RCA	2N4314

AMPLIFIER (A3) 04-117-507

REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
R36,37	Resistor, Film, 47Ω, 1/4W, 10%	40-012-012	Allen-Bradley	CB
R29,30	Resistor, Film, 15Ω, 1W, 1%	40-002-007	IRC	CEC
R26	Resistor, Film, 56.2Ω, 1W, 1%	40-002-021	IRC	CEC
R22	Resistor, Film, 68.1Ω, 1W, 1%	40-002-023	IRC	CEC
R20,28,38	Resistor, Film, 100Ω, 1W, 1%	40-002-027	IRC	CEC
R5	Resistor, Film, 150Ω, 1W, 1%	40-002-031	IRC	CEC
R25,34	Resistor, Film, 182Ω, 1W, 1%	40-002-033	IRC	CEC
R16,18	Resistor, Film, 1K, 1W, 1%	40-002-053	IRC	CEC
R7,11,15,23	Resistor, Film, 1.82K, 1W, 1%	40-002-059	IRC	CEC
R9,14	Resistor, Film, 2.21K, 1W, 1%	40-002-063	IRC	CEC
R12	Resistor, Film, 2.74K, 1W, 1%	40-002-065	IRC	CEC
R4,24	Resistor, Film, 3.32K, 1W, 1%	40-002-067	IRC	CEC
R8,10	Resistor, Film, 5.62K, 1W, 1%	40-002-073	IRC	CEC
R32	Resistor, Film, 8.25K, 1W, 1%	40-002-077	IRC	CEC
R2	Resistor, Film, 10K, 1W, 1%	40-002-079	IRC	CEC
R17	Resistor, Film, 12.1K, 1W, 1%	40-002-081	IRC	CEC
R6,13	Resistor, Film, 27.4K, 1W, 1%	40-002-089	IRC	CEC
R35	Resistor, Film, 221K, 1W, 1%	40-002-111	IRC	CEC
R27	Resistor, Power, 1K, 15W, 5%	40-221-001	Hardwick-Hindle	BRS
R3,33	Resistor, W-W, 10K, .33W, 0.1%, 7ppm/°C	40-187-002	Daven	1301
R40	Resistor, Film, 3.9K, 1/4W, 5%	40-003-024	Allen-Bradley	CB
C2,4,5,9,11,14	Capacitor, Ceramic, .03μf, 50V, +80% -20%	45-902-002	Centralab	CK-303
C13	Capacitor, Mica, 10pf, 300V, ±.5pf	45-001-005	Electro-Motive	DM 15C
C10	Capacitor, Mica, 180pf, 300V, 3%	45-003-013	Electro-Motive	DM 15F
C3	Capacitor, Mica, 470pf, 300V, 3%	45-003-023	Electro-Motive	DM 15F
C1	Capacitor, Mica, 1000pf, 300V, 3%	45-004-001	Electro-Motive	DM 19F
C8	Capacitor, Mica, 2200pf, 300V, 3%	45-004-009	Electro-Motive	DM 19F
C12	Capacitor, Mylar, 0.1μf, 200V, 10%	45-108-501	Sprague	192P

AMPLIFIER (A3) 04-117-507 CONTINUED

REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
CR1-3	Diode, Silicon, 200mA, 120 PIV	35-001-001	Fairchild	1N658
CR4	Diode, Silicon, Reference, 24V, 400mW	35-051-025	Motorola	MZ500
Q7	Transistor, PNP Silicon	30-033-001	**	--
Q5	Transistor, PNP Silicon	30-038-001	**	2N3906
Q6,8,11	Transistor, NPN Silicon	30-039-001	Sprague	TN53
Q1-4	Transistor, NPN Silicon	30-040-011	**	--
Q9	Transistor, PNP Silicon	30-054-001	Motorola	2N3634
Q10	Transistor, NPN Silicon	30-011-021	**	--
TP1	Test Jack, P.C. Red	29-024-001	H.H. Smith	430-102
HS1,2,3	Heat Sink, Top Hat, JEDEC Type TO-5	55-003-001	Wakefield Eng.	207
HS4	Heat Sink, Top Hat, JEDEC Type TO-5	55-003-002	Wakefield Eng.	209

SW1-B BOARD 04-117-508

REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
R1,2,3,4	Resistor, Film, 47.5K, 1W, 1%	40-002-095	IRC	CEC
R5	Resistor, Film, 1 Meg, 1W, 1%	40-002-127	IRC	CEC
R6	Resistor, Film, 100K, 1W, 1%	40-002-103	IRC	CEC
C2	Capacitor, Aluminum, 10μf, 15V	45-215-051	Sprague	30D
C1	Capacitor, Aluminum, 100μf, 25V	45-215-003	Sprague	30D
C4	Capacitor, Mylar, .15μf, 200V, 10%	45-110-501	Sprague	192P
C3	Capacitor, Mylar, 0.82μf, 100V, 20%	45-129-003	Elpac	ZD
SW1-B	Switch, Rotary, 2 Pole, 5 Pos.	34-063-002	CTS	212

SW1-C BOARD 04-117-508

REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
R3,6	Resistor, Composition, 6.8M, 1/2W, 5%	40-009-025	Allen-Bradley	CB
R1,4	Resistor, Film, 68K, 1W, 1%	40-002-099	IRC	CEC
R2,5	Resistor, Film, 680K, 1W, 1%	40-002-123	IRC	CEC
C14	Capacitor, Mica, 330pf, 300V, 2%	45-003-219	Electro-Motive	DM 15F
C15	Capacitor, Variable, .8-30pf, 1kV	45-510-001	Erie	569-013
SW1-C	Switch Rotary, 2 Pole, 5 Pos.	34-063-002	CTS	212
	Capacitor Trim Package	23-117-297-1	Weston	--
	Capacitor Trim Package	23-117-297-2	Weston	--
	Capacitor Trim Package	23-117-297-3	Weston	--

SW1-D BOARD 04-117-508

REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
R3	Resistor, Composition, 6.8M, 1/2W, 5%	40-009-025	Allen-Bradley	EB
R1	Resistor, Film, 68K, 1W, 1%	40-002-099	IRC	CEC
R2	Resistor, Film, 680K, 1W, 1%	40-009-123	IRC	CEC
R4	Resistor, Composition, 150MΩ, 1/2W, 5%	40-009-028	Allen-Bradley	EB
R5	Resistor, Film, 15Ω, 1W, 1%	40-002-007	IRC	CEC
R8	Resistor, Film, 18.2Ω, 1W, 1%	40-002-009	IRC	CEC
R7	Resistor, Film, 33.2Ω, 1W, 1%	40-002-015	IRC	CEC
R10	Resistor, Variable, PC Type, 500Ω, 2W	40-413-003	Clarostat	39
C14	Capacitor, Mica, 330pf, 300V, 2%	45-003-219	Electro-Motive	DM 15F
C15	Capacitor, Variable, .8-30pf, 2kV	45-510-001	Erie	569-013
C16	Capacitor, Mica, 1800pf, 300V, 3%	45-004-007	Electro-Motive	DM 19F
SW1-D	Switch, Rotary, 5 Pos.	34-063-002	CTS	212
	Capacitor Trim Package	23-117-297-1	Weston	--
	Capacitor Trim Package	23-117-297-2	Weston	--
	Capacitor Trim Package	23-117-297-3	Weston	--

SW1-E BOARD 04-117-508

REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
R4	Resistor, Film, 10K, 1W, 1%	40-002-079	IRC	CEC
R2	Resistor, Film, 6.81K, 1W, 1%	40-002-075	IRC	CEC
R6	Resistor, Film, 8.25K, 1W, 1%	40-002-077	IRC	CEC
R8	Resistor, Film, 5.62K, 1W, 1%	40-002-073	IRC	CEC
R1,3,5,7	Resistor, Film, 100K, 1W, 1%	40-002-103	IRC	CEC
C8	Capacitor, Mica, 4700pf, 300V, 3%	45-005-001	Electro-Motive	DM 20F
C6,7	Capacitor, Mylar, .047μf, 100V, 20%	45-129-001	Elpac	ZD
C4,5	Capacitor, Mylar, .47μf, 100V, 20%	45-129-002	Elpac	ZD
C2	Capacitor, Mylar, 4μf, 100V, 20%	45-122-101	Good-All	X663F
C3	Capacitor, Mylar, 5μf, 100V, 20%	45-122-102	Good-All	X663F
C1A,B,C,D	Capacitor, Mylar, 10μf, 100V, 20%	45-122-103	Good-All	X663F
SW1-E	Switch, Rotary, 2 Pole, 5 Pos.	34-063-002	CTS	212

BACKBOARD 04-117-508

REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
R25	Resistor, Film, 100K, 1W, 1%	40-002-103	IRC	CEC
R3,7	Resistor, Variable, 50Ω, 2W	40-413-001	Clarostat	39
R2,11	Resistor, Variable, 500Ω, 2W	40-413-003	Clarostat	39
R1	Resistor, Film, 82K, 1W, 1%	40-002-101	IRC	CEC
R26,27	Resistor, Film, 10K, 1W, 1%	40-002-079	IRC	CEC
J1	Connector, Male 29 Pin	29-032-129	Elco	7023
J6	Connector, Female	29-033-132	Amphenol	26-4200
C7,8	Capacitor, Aluminum, 1300μf, 100V	45-221-451	Mallory	CG
C1,2,3,4,5,6	Capacitor, Aluminum, 2600μf, 50V	45-218-352	Sprague	36D

OPTION 05

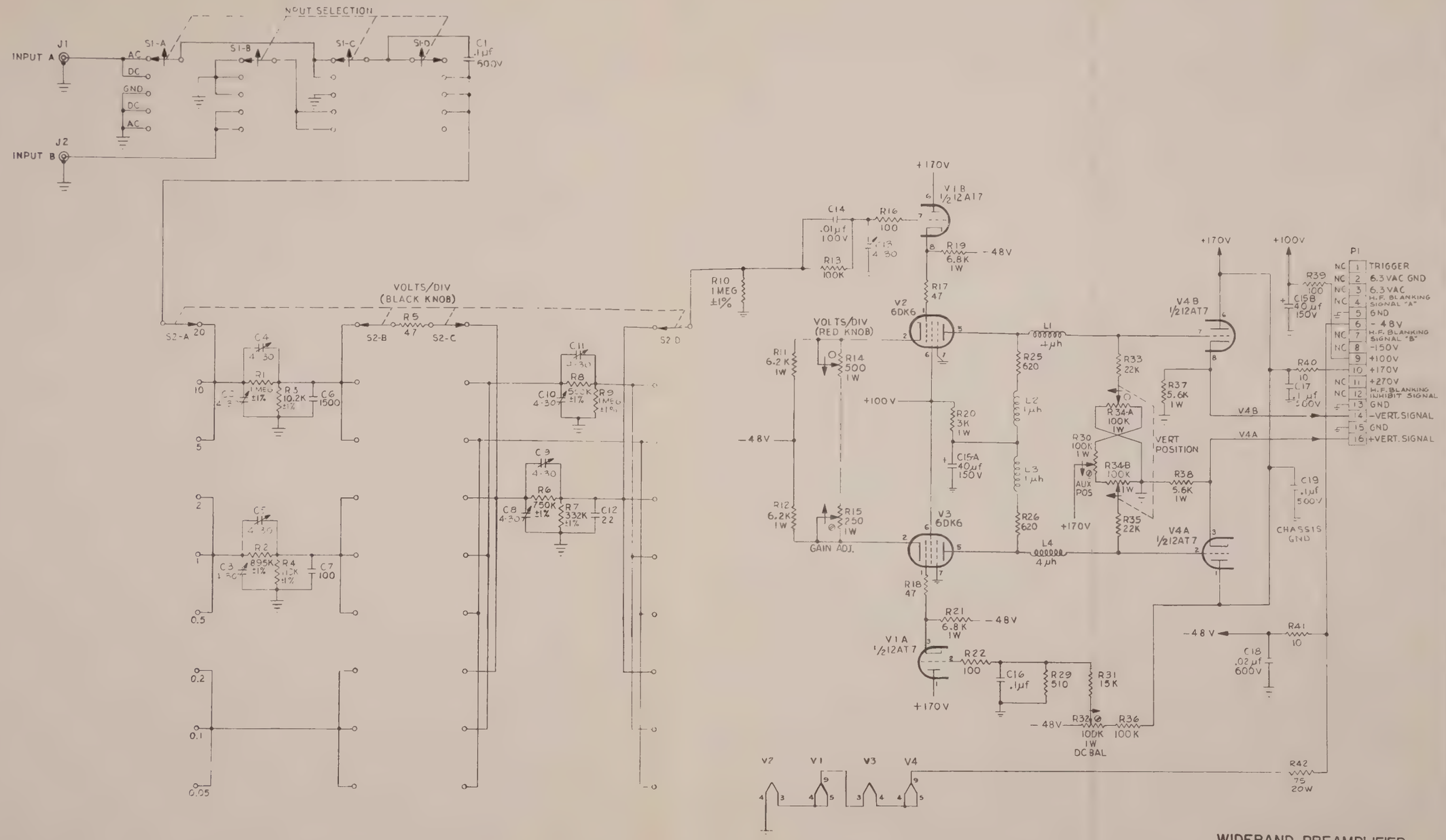
REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
External Sync.	Assy., A4 Option 05 Board	14-117-087	Weston-Lex.	Reference
	Mach., A4 Option 05 Board	13-117-086	Weston-Lex.	Reference
C1,2	Capacitor, Tantalum, 47μf, 20V, 20%	45-407-001	Sprague	150D
CR1,2	Diode, Silicon Reference, 10V, 400mW	35-051-016	Motorola	MZ500
R1,5	Resistor, Film, 6.81K, 1W, 1%	40-002-075	IRC	CEC
R2	Resistor, Film, 1.82K, 1W, 1%	40-002-059	IRC	CEC
R3	Resistor, Film, 8.25K, 1W, 1%	40-002-077	IRC	CEC
R4	Resistor, Film, 825Ω, 1W, 1%	40-002-051	IRC	CEC
	REAR PANEL			
	Cover Plate Type II	03-117-103	Weston-Lex.	Reference
XF2	Fuseholder	33-001-001	Little Fuse	34 2012
F2	Fuse 1/32 Amp	33-011-006	Buss	AGC
S4	Switch, Slide, 3 Pole, Double Throw	34-062-004	Stackpole	SS-34

OPTION 07, GUARD DRIVER 04-117-512

REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
J3	Connector, 4 Pin, Female	29-034-104	Switch Craft	2504FP
P3	Connector, 4 Pin, Male	29-034-204	Switch Craft	2504M
TB1	Guard Driver Amp	14-117-234	Weston-Lex.	Reference
	Mach., Guard Driver Amp	13-117-233	Weston-Lex.	Reference
C2,3,4	Capacitor, Ceramic, .03μf, 50V, +80% -20%	45-902-002	Cramer	CK-303
C5	Capacitor, Mylar, .01μf, 100V, 10%	45-102-004	Electro-Motive	P710411
CR1,2	Diode, Silicon, Sw	35-005-001	Texas Inst.	1N916
R5,15	Resistor, Film, 10K, 1W, 1%	40-002-079	IRC	CEC
R2,6,10	Resistor, Film, 4.75K, 1W, 1%	40-002-071	IRC	CEC
R3	Resistor, Film, 274K, 1W, 1%	40-002-113	IRC	CEC
R4	Resistor, Film, 221K, 1W, 1%	40-002-111	IRC	CEC
R7,8	Resistor, Film, 56.2Ω, 1W, 1%	40-002-021	IRC	CEC
R9	Resistor, Film, 2.21K, 1W, 1%	40-002-063	IRC	CEC
R11,16	Resistor, Film, 47.5Ω, 1W, 1%	40-002-019	IRC	CEC
R12,13	Resistor, Film, 15Ω, 1W, 1%	40-002-007	IRC	CEC
R14	Resistor, Film, 10Ω, 1W, 1%	40-002-003	IRC	CEC
Q3	Transistor, PNP Silicon	30-038-001	Motorola	2N3906
Q1	Transistor, Diffused Silicon	30-045-001	Fairchild	2N3645
Q2	Transistor, Silicon NPN	30-040-011	**	--
Q4	Transistor, PNP Silicon - High Power	30-054-001	Motorola	2N3634
Q5	Transistor, NPN Silicon	30-082-001	Motorola	MJE340

OPTION 08, FLATNESS

REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
R28,29,30,31	Resistor, Trim	*	--	--



5. R23, R24, R27 & R28 NOT USED
4. R14 IS COAXIAL WITH SWITCH S2.
3. LAST R USED IS R42.
2. LAST C USED IS C19.
1. RESISTORS ARE IN OHMS, ±5%, 1/2W; CAPACITORS ARE IN µµf, ±5%, 500V, UNLESS OTHERWISE SPECIFIED.

WIDEBAND PREAMPLIFIER
MODEL 05-1
SCHEMATIC

Dwg. No. A-106510

A-106510 L1

Serial Number _____

OPERATING AND SERVICE MANUAL

MODEL 111

VOLTAGE DIVIDER

SECOND EDITION (6/25/69)

WESTON-LEXINGTON
Weston Instruments Division
17 Hartwell Avenue
Lexington, Massachusetts 02173

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TABLE OF CONTENTS

Section	Title	Page
1.	Description and Specifications	1-1
1.1.	General Description	1-1
1.2.	Uses	1-1
1.3.	Specifications	1-2
2.	Installation and Operation	2-1
2.1.	Installation	2-1
2.2.	Operating Considerations	2-1
2.2.1.	Output Impedance	2-1
2.2.2.	Plug-In Current Drain With Load	2-1
2.2.3.	Capacitive Loading	2-2
2.3.	Operating Procedure	2-2
2.4.	Impedance Adaptors	2-3
3.	Theory of Operation	3-1
4.	Calibration	4-1
4.1.	DC Performance Test and Calibration	4-1
4.2.	AC Performance and Calibration Procedure	4-2
4.2.1.	Feedthrough Reduction Trim	4-2
4.2.2.	Frequency Response Testing	4-3
5.	Circuit and Location Diagrams	5-1
6.	Replaceable Parts	6-1

LIST OF ILLUSTRATIONS

Figure	Title	Page
2-1	Front Panel Controls and Connectors	2-4
3-1	Simplified Schematic	3-1
3-2	Feedthrough Compensation	3-2
4-1	DC Performance Calibration Setup	4-5
4-2	Frequency Response Setup	4-5

W A R R A N T Y

Weston-Lexington warrants each instrument manufactured by them to be free from defects in material and workmanship. Our liability under this Warranty is limited to servicing or adjusting any instrument returned to the factory for that purpose, and to replace any defective parts thereof. This Warranty is effective for one year after delivery to the original purchaser when the instrument is returned, transportation charges prepaid by the original purchaser, and when upon our examination it is disclosed to our satisfaction to be defective. If the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed to the customer. In this case, an estimate will be submitted before the work is started.

IN ANY FAULT DEVELOPS, THE FOLLOWING STEPS SHOULD BE TAKEN:

1. Notify us giving full details of the difficulty; include the Model number and serial number. On receipt of this information, we will give you service data or shipping instructions.
2. On receipt of shipping instructions, forward the instrument prepaid to the factory or to the authorized repair station indicated on the instructions. If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the Warranty.

SECTION 1

DESCRIPTION AND SPECIFICATIONS

1.1. GENERAL DESCRIPTION

The Model 111 plug-in is a high-resolution voltage divider providing good accuracy and exceptional frequency response when used with the Weston 100 series Precision Oscillators at a constant 200Ω output impedance over the frequency range from 10Hz to 100kHz. The plug-in consists of a three-decade plus vernier wide-band voltage divider which divides the output of the oscillator from 0 to 12 volts over four multiplier ranges. Complete specifications are given in Section 1.3. The decade divider has settings from 0.00 to 12.10 (11.XX) with a continuously variable vernier covering 0.000 to 0.00X. The four multiplier ranges are X1, X0.1, X0.01 and X0.001. Resolution of better than one microvolt is available on the X0.001 multiplier range with the vernier covering the range from 0 to 10 microvolts. A floating output connector is included which isolates the divider circuit ground from the chassis ground and allows for floating operation when the oscillator switch is in the floating position. (See 100 series oscillator manual for floating operation.)

1.2. USES

Flat frequency-response, constant output-impedance, high resolution, and accuracy make the combination of the Model 111 plug-in and Weston Precision Oscillator useful in such applications as frequency-response testing from 1mV to 12 volts, distortion analysis, and measuring the gain of an amplifier or system. With the fixed high-level reference output available from the basic oscillator and Model 111 plug-in providing low-level

signals, suppressed-carrier systems which utilize phase-sensitive demodulators can be easily evaluated. With a quadrature reference also available from the oscillator, quadrature rejection of phase-sensitive systems can also be analyzed.

1.3. SPECIFICATIONS

Number of Phases:	1 (ØA)
Controls:	4 decade divider with a X1, X0.1, X0.01 and X0.001 range multiplier which provides 1 microvolt per division in the X0.001 multiplier position. 4th decade is a potentiometer.
Output Voltage Settings:	0 to 12.11 volts (X1 range) 0 to 1.211 volts (X0.1 range) 0 to 0.1211 volts (X0.01 range) 0 to 0.01211 volts (X0.001 range)

Total Frequency Response Including Oscillator				
Range Position	10Hz-20Hz	20Hz-20kHz	20kHz-50kHz	50kHz-100kHz
X1‡	0.02% ±0.1mV	0.01% ±0.15mV	0.02% ±0.2mV	0.05% ±0.3mV
X0.1‡	0.02% ±20μV	0.01% ±20μV	0.05% ±30μV	0.07% ±50μV
X0.01‡	0.02% ±2μV	0.02% ±2μV	0.07% ±10μV	0.1% ±20μV
X0.001	0.02% ±1μV	0.05% ±1μV	0.1% ±3μV	0.15% ±5μV

Accuracy at 1kHz‡	±0.25% X1 range ±0.35% X0.1 range ±0.45% X0.01 range ±0.55% X0.001 range

‡With first digit not set to zero

Amplitude Stability Vs. Temperature‡ (total including oscillator):	±0.03%/°C
Output Impedance:	200Ω ±0.2%
Available Output Current:	Matched 200Ω load; 30mA max. *Short circuit load; 60mA max.
Maximum Input Current to Plug-in:*	No load on plug-in; 23mA in X1, 27mA in X0.1, X0.01 and X0.001. Matched 200Ω load; 47mA. Plug-in "short circuit" load, 9V setting and below; 55mA. *Plug-in "short circuit" load; above 9V setting; 78mA.
Output:	Front panel BNC connector.
Temperature Range for Specified Performance:	15° - 40°C
Operating Temperature Range:	0° - 52°C
Shock and Vibration:	Designed to meet all performance specifications after being subjected to the applicable shock and vibration requirements of MIL-T-945.
Dimensions and Weight:	4-1/8" h x 5-3/16" w x 5-9/16" d behind front panel (excluding connector); 2-1/2 lbs.

*Current available from oscillator front panel fixed output in mA equals 60 less plug-in input current. If the input current to the plug-in exceeds 60mA, distortion and frequency response will be slightly degraded due to overloading the oscillator.

SECTION 2

INSTALLATION AND OPERATION

2.1. INSTALLATION

The plug-in module has been designed to fit into the front panel receptacle on the Precision Oscillator (see Precision Oscillator manual). Before inserting plug-in into the receptacle, place plug-in locking latch (see Figure 2-1) in a position such that the plug-in will slide completely into the receptacle. When fully inserted, the front panel of the plug-in should be flush with the oscillator front panel. Turn locking latch in the clockwise direction to lock the plug-in firmly in place.

2.2. OPERATING CONSIDERATIONS

2.2.1. OUTPUT IMPEDANCE

For full accuracy and ease of application, the load impedance should be as high as possible (greater than 400KΩ). The divider itself is calibrated for no load, with a matched 200Ω load, the output voltage will be half the indicated value. For any load (R_L), the output voltage equals:

$$\text{Divider output} = \frac{R_L}{R_L + 200} \times \text{dial setting}$$

where R_L is in ohms.

2.2.2. PLUG-IN CURRENT DRAIN WITH LOAD

The output amplifiers in the oscillator are rated at 60mA maximum for full specification. Because their outputs are brought directly to the front panel of the oscillator at a low impedance level, it is possible to draw more than 60mA. Although

this does not harm the amplifiers in any way, the oscillator specifications are no longer maintained. When a divider plug-in is being driven by the amplifiers, the total current available at the low impedance front-panel outputs is reduced by the amount used by the plug-in. The currents for different loads on the divider must be subtracted from the specified 60mA level to determine how much current is still available from the zero impedance output. For the Model 111PM plug-in, only phase A is used, allowing phase B low-impedance oscillator front-panel output to supply 60mA regardless of the load on the divider output. (See specifications, Section 1.3., for input current for different loads).

2.2.3. CAPACITIVE LOADING

A capacitive load on the divider will affect the frequency response of the output voltage from the divider. With capacitive loading, the following formula should be used to calculate additional frequency-response error:

$$\text{Additional \% error} \approx 0.78 f^2 \times 10^{-10} \left[(C_{ext} + 50)^2 - (50)^2 \right]$$

where: C_{ext} is in pf

f is in kHz

2.3. OPERATING PROCEDURE

a. Insert plug-in into oscillator receptacle on front panel (see Section 2.1.).

NOTE: The oscillator need not be turned off when plug-ins are inserted or removed.

b. Set dials and multiplier switch to the desired voltage (see Section 2.2.1. for heavy loads).

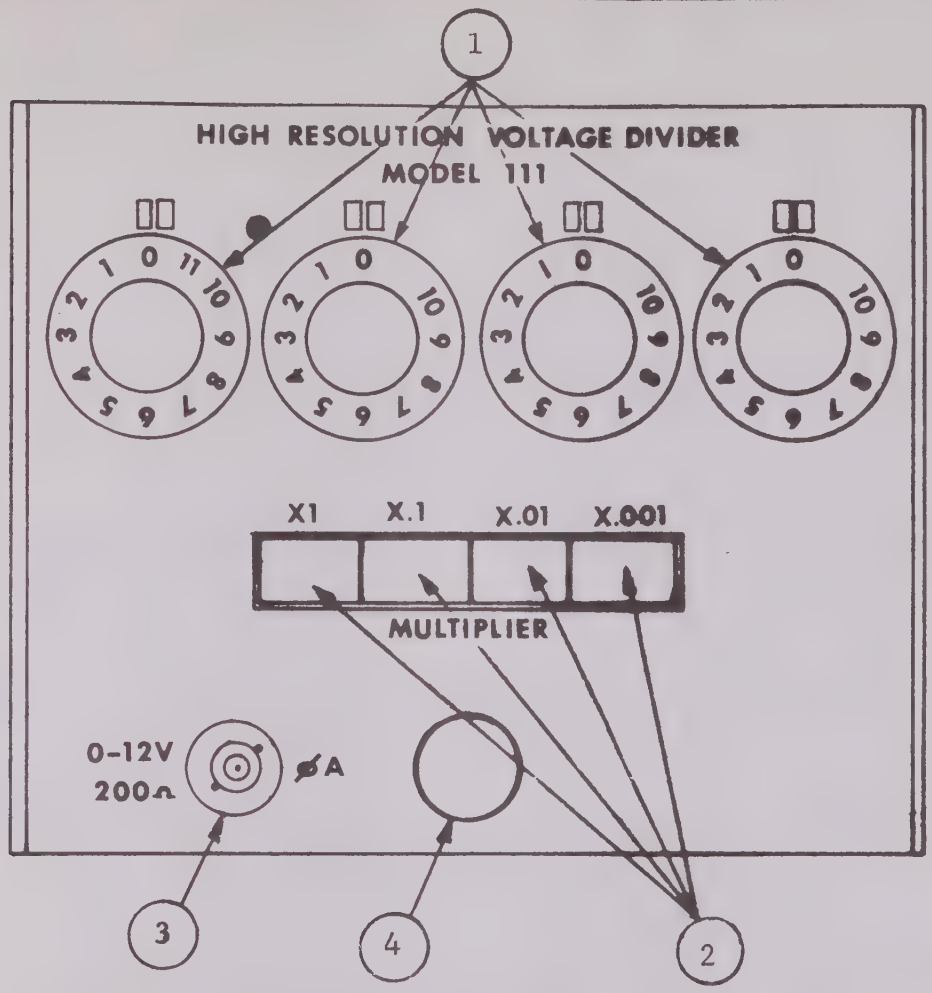
c. Attach load to the output connector on the front of the plug-in.

2.4. IMPEDANCE ADAPTORS

Some loads are affected by an impedance mismatch, or frequency response may be degraded due to large capacitive loads. For such cases, impedance adaptors may be necessary. The following is a list of adaptors and their part numbers which are available as accessories:

200Ω to 600Ω adaptor - Weston Part No. 02-117-308

200Ω to 50Ω X10 attenuator - Weston Part No. 02-117-207



1. DIVIDER SWITCHES AND VERNIER (SW10, 11, 12 and R134) divides Precision Oscillator phase A output from 12.10 volt to 1μV when used in conjunction with the multiplier ranges.

2. MULTIPLIER RANGES (SW13, 14, 15 and 16) provide multiplication of divider switches by X1, X0.1, X0.01 and X0.001.

3. OUTPUT (J111) attenuated phase A output of Precision Oscillator.

4. PLUG-IN LOCKING LATCH, turn fully counter-clockwise to insert or remove plug-in, fully clockwise to lock plug-in into oscillator.

Figure 2-1. Front Panel Controls and Connectors

SECTION 3

THEORY OF OPERATION

The Model 111 plug-in is shown in simplified form in Figure 3-1, below.

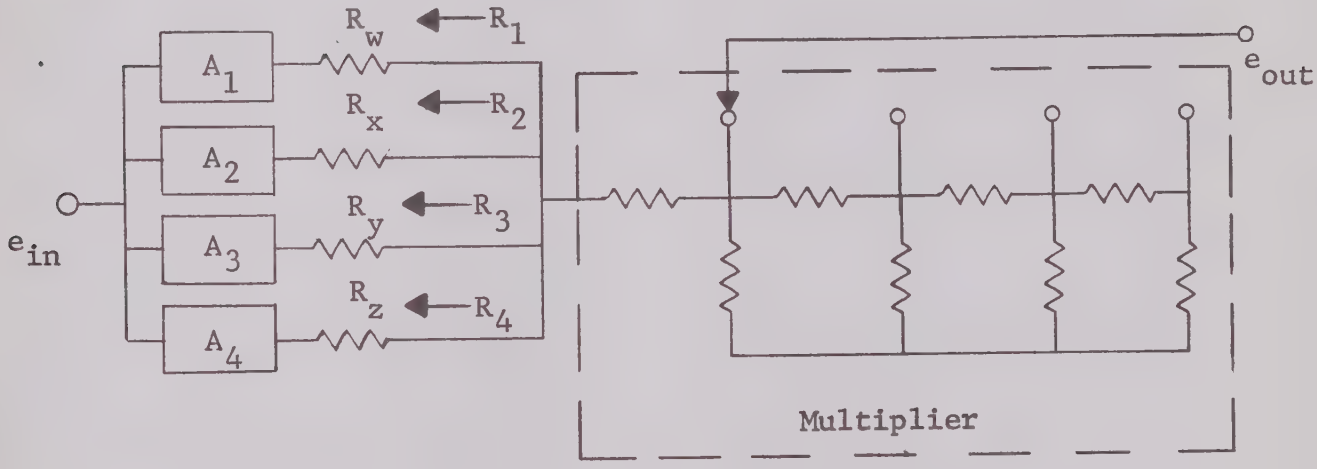


Figure 3-1
Simplified Schematic

Most precision dividers (Kelvin-Varley, etc.) yield fine ratio accuracies, but output impedance varies with setting. This change in loading is not desirable as it seriously affects voltage accuracy under load.

In Figure 3-1, A_1 represents a switched potentiometer. Different resistors are selected for each switch position such that R_1 is held constant with switch setting (see Schematic 04-117-511-1). A_2 and A_3 are similar to A_1 except that R_x and R_y must also act as weighting resistors such that the full-scale effect of A_2 is 1/12 A_1 and the full-scale effect of A_3 is 1/10 A_2. A_4 is a true potentiometer whose weighting resistor R_z is large

enough to make R_4 essentially constant with potentiometer setting. With this weighting resistor, the full-scale effect of A_4 is 1/1200 of A_1.

The total effect of A_1, A_2, A_3 and A_4 plus their associated resistors is a linear continuously-adjustable divider with constant (±0.25%) output impedance. The multiplier is a simple ladder attenuator with a high degree of shielding between input and output to maintain the frequency response of the divider to low voltage setting. There is, however, still some feedthrough capacitance from input to output at low divider settings and at high frequencies which has been drastically reduced by additional compensation circuitry. Figure 3-2 shows in block diagram form the technique used to reduce this effect. In Figure 3-2, an equal but opposite amount of the signal current is generated by a source which is exactly 180° out of phase with the divider input source. The net result is a drastic reduction in the error caused by the feedthrough capacitance.

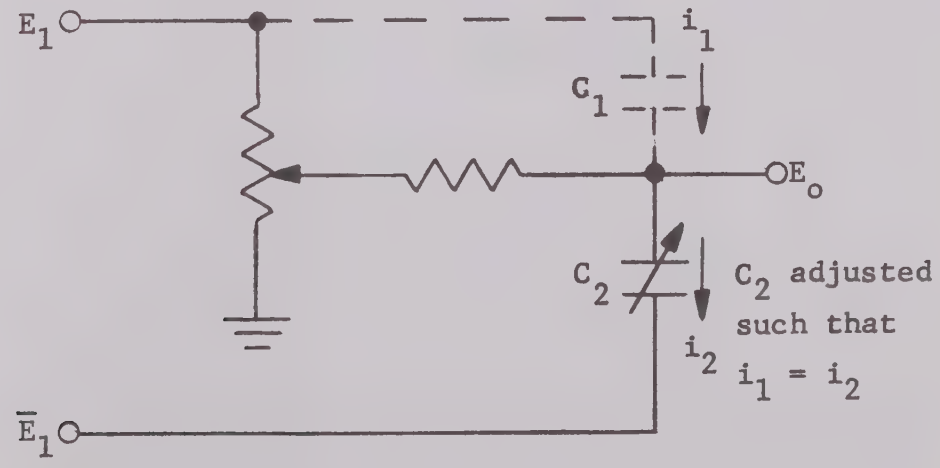


Figure 3-2

Feedthrough Compensation

SECTION 4

CALIBRATION

4.1. DC PERFORMANCE TEST AND CALIBRATION

The dc performance test setup is illustrated in Figure 4-1. A DC power supply (EDC Model VS-111, or equivalent) and a digital voltmeter (Weston Model 1423, or equivalent) are required for this test. The purpose of this test is to check, and if necessary, calibrate the divider. To perform the test, proceed as follows:

a. Make test setup illustrated in Figure 4-1.
b. Set decade dials and vernier to read 1.000.
c. Set multiplier switch to X1.
d. Apply 12.11 volts to plug-in as shown in Figure 4-1.
e. The output of the divider is now read on the digital voltmeter and should be 1V ±2.5mV. If the output is not within this limit, adjust R13 until the output is within specifications.
f. Set dials to read 2.000.
g. Keep multiplier at X1 position.
h. Read output on digital voltmeter. Output should be 2V ±5mV. Adjust R11 until output is within specifications.
i. Because of interaction between trims, repeat steps b. through h. until all requirements are satisfied.
j. Set dials to read 10.00 and multiplier to X0.1.
k. Read output on digital voltmeter. Output should be 1V ±3.5mV. Adjust R87 until output is within specifications.

l. With dials set to 10.00, set multiplier to X0.01.

m. Read output on digital voltmeter. Output should be 0.1V ±450μV. Adjust R92 until output is within specifications.

n. With dials set to 10.00, set multiplier to X0.001.

o. Read output on digital voltmeter. Output should be 0.01V ±55μV. Adjust R97 until output is within specifications.

p. With multiplier switch set to X1, switch first decade through each position and observe output on digital voltmeter. The output should be within ±0.25% of dial indication.

q. A check on every decade is not necessary. A quick check can be made with the dials set to 1.111 and 1.555 volts and the multiplier switch set to X1. The output should be within ±0.25% of dial reading.

4.2. AC PERFORMANCE AND CALIBRATION PROCEDURE

The ac performance and calibration test consists of two parts: a) feedthrough reduction trim, and b) frequency response. Part a should be performed before part b, as feedthrough will affect the divider frequency response.

4.2.1. FEEDTHROUGH REDUCTION TRIM

a. Insert plug-in oscillator as outlined in Section 2.1.

b. Remove oscillator top cover (see oscillator manual for instructions).

c. Turn oscillator on and set frequency to 100kHz.

d. Set plug-in dials and vernier to zero and multiplier switch to X1.

e. Measure output on VTVM (H-P Model 400D, or equivalent).

f. If output is greater than 300μV, adjust capacitor C2 in plug-in until output is less than 300μV.

4.2.2. FREQUENCY RESPONSE TESTING

The frequency response of the divider is controlled by two factors: 1. The geometry of the divider, and 2. The capacitance and/or inductance in the resistors. Very complicated techniques have been developed to measure divider frequency response at low level settings which would be very difficult to perform in most calibration laboratories. For this reason a two-poing frequency-response test at high level outputs will generally be sufficient to guarantee that geometry and resistors have not changed. Figure 4-2 shows a typical test setup. To perform the test, proceed as follows:

a. Insert plug-in into oscillator.

b. Turn oscillator on and set to 400Hz; set plug-in dials to read 6.000 and multiplier to X1.

c. Connect 5 volt high-frequency thermal converter (HFTC Engelhard Industries Part No. 34970-10C, or equivalent) to the divider output.

NOTE: Because we are only interested in frequency response, the decrease in output voltage due to loading by the converter is inconsequential.

d. Using the HFTC as a transfer device, measure the plug-in output.

e. Set the oscillator frequency to 100kHz and repeat step d. This reading should not exceed ±0.05% of the reading of step d.

f. Set plug-in dials to read 1.000 and multiplier to X1.

g. Using a 1 volt HFTC, repeat steps c., d., and e. The difference between the 400Hz reading and 100kHz reading should not exceed ±0.08%.

h. Step g. may be repeated on the X0.1 multiplier position by setting the divider dials to read 10.000 and the multiplier to X0.1. The 1 volt HFTC would still be used for this test. The difference between the 400Hz, and 100kHz reading should not exceed ±0.075%.

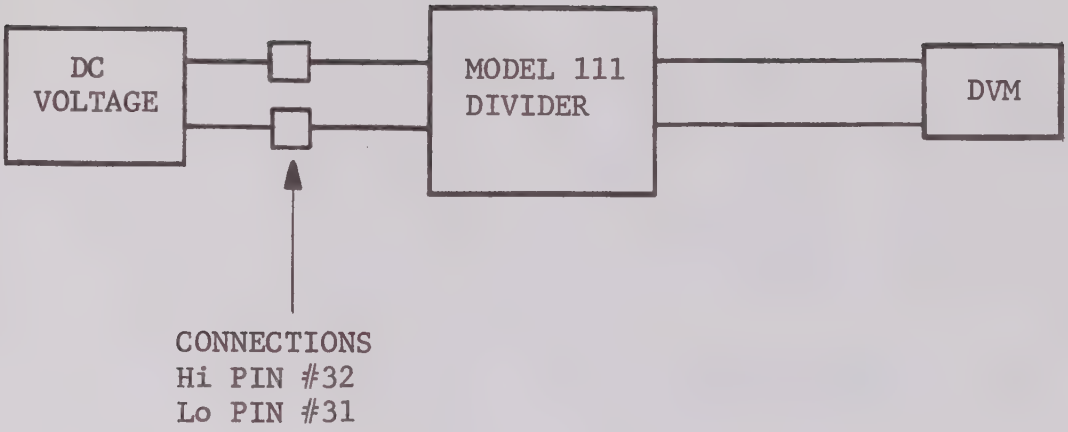


Figure 4-1. DC Performance Calibration Setup

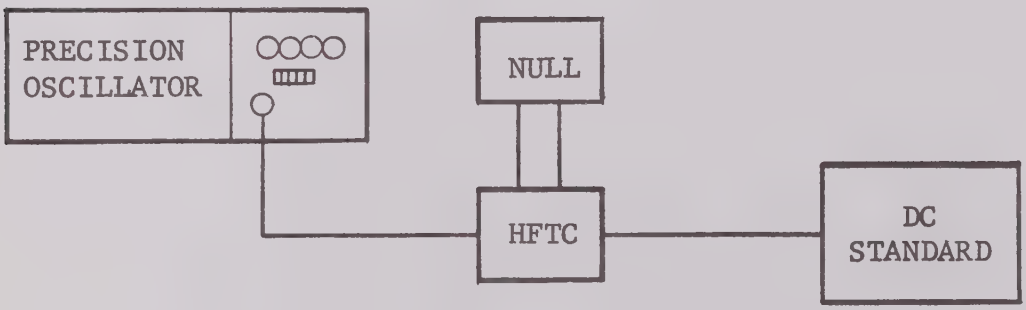


Figure 4-2. Frequency Response Setup

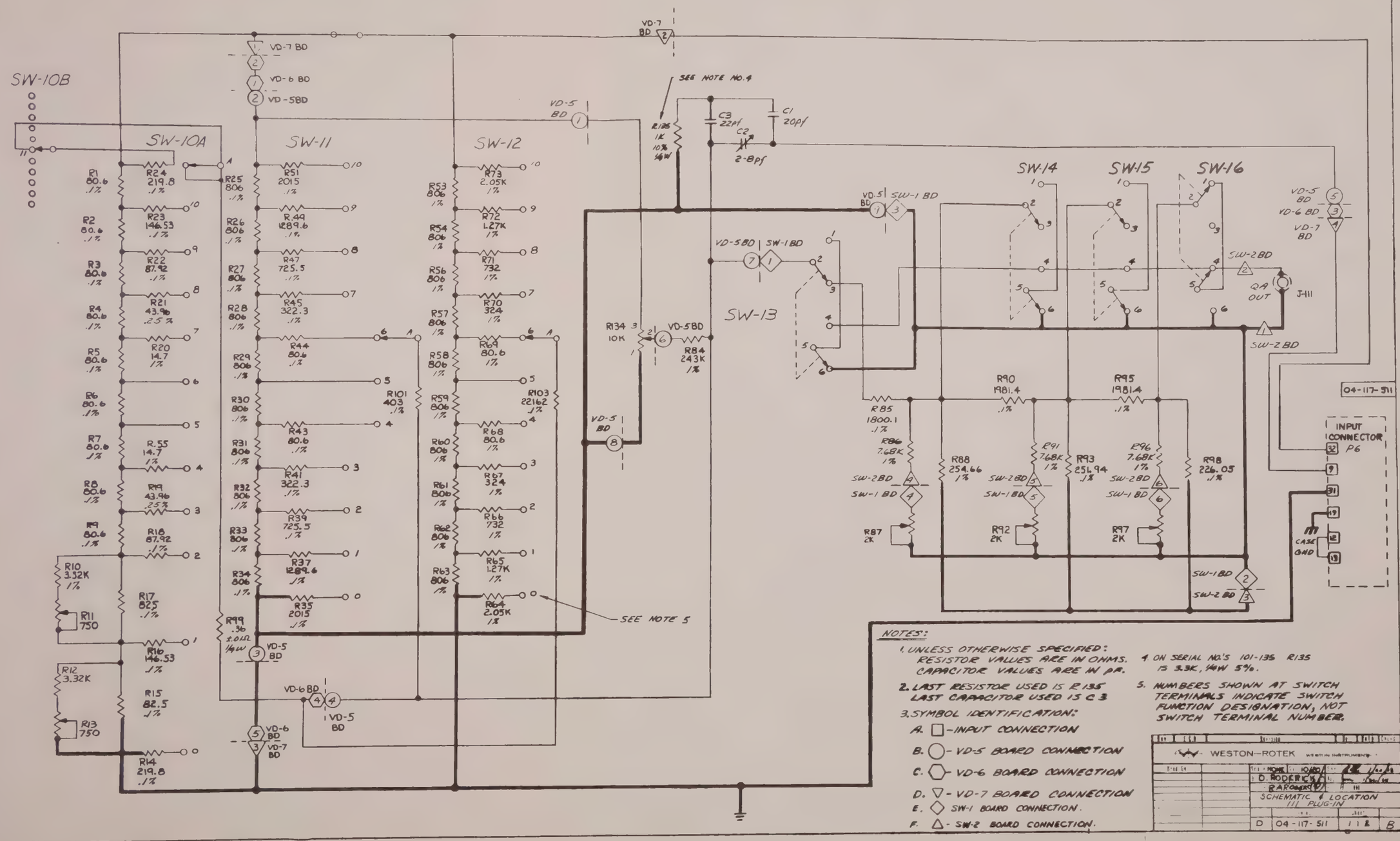
SECTION 5

CIRCUIT AND LOCATION DIAGRAMS

This section contains the overall schematic and location diagrams for the Model 111 Voltage Divider. The schematic is an overall schematic of the plug-in, and when used in conjunction with the Theory of Operation (Section 3.), should aid in understanding full operation of the plug-in.

Following is a list of the diagrams included in this section:

Number	Title
04-117-511-1	Schematic, 111 Plug-In
04-117-511-2	Location, 111 Plug-In



NOTES:

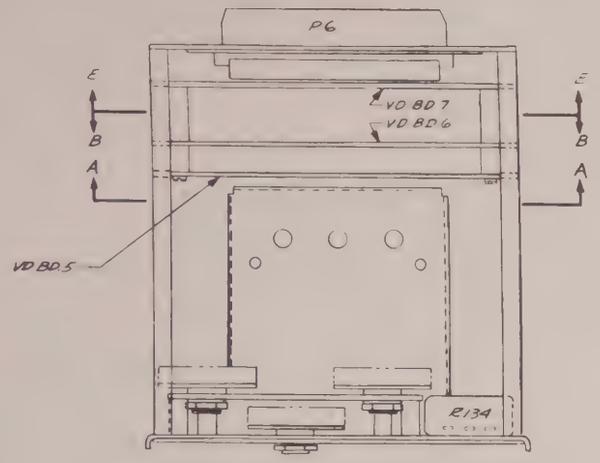
1. UNLESS OTHERWISE SPECIFIED: RESISTOR VALUES ARE IN OHMS. CAPACITOR VALUES ARE IN pF.
2. LAST RESISTOR USED IS R135 LAST CAPACITOR USED IS C3
3. SYMBOL IDENTIFICATION:
   - A. □ - INPUT CONNECTION
   - B. ○ - VD-5 BOARD CONNECTION
   - C. ⬡ - VD-6 BOARD CONNECTION
   - D. ▽ - VD-7 BOARD CONNECTION
   - E. ◇ - SW-1 BOARD CONNECTION.
   - F. △ - SW-2 BOARD CONNECTION.
4. ON SERIAL NO.'S 101-135 R135 IS 3.3K, 1/4W 5%.
5. NUMBERS SHOWN AT SWITCH TERMINALS INDICATE SWITCH FUNCTION DESIGNATION, NOT SWITCH TERMINAL NUMBER.

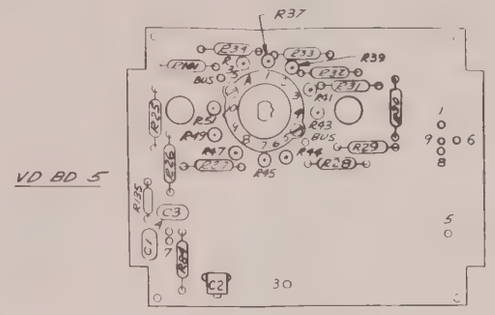
WESTON—ROTEK

D. RODERICK

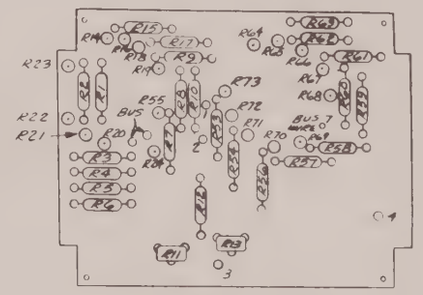
SCHEMATIC & LOCATION
III PLUG-IN

D | 04-117-511 | 1 | 8 | B

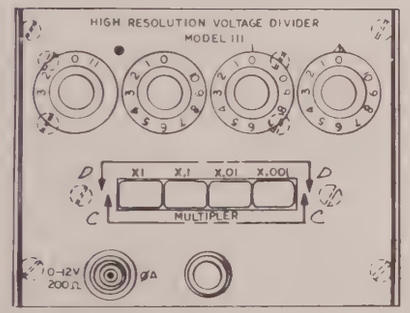


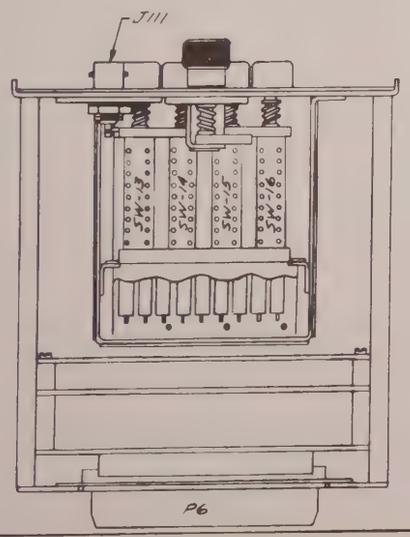


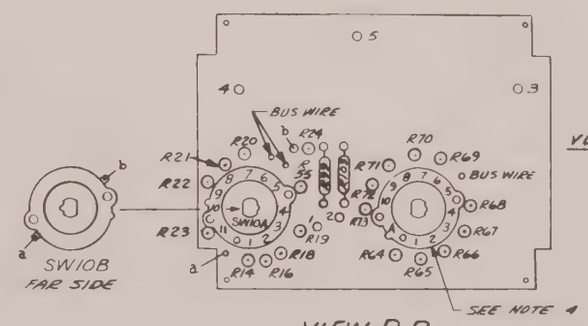
VIEW A-A



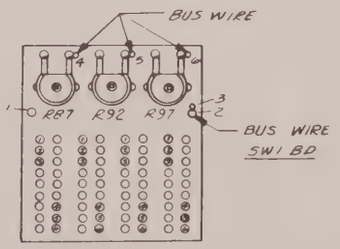
VIEW E-E



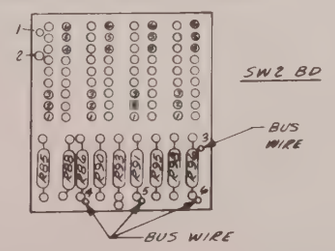




VIEW B-B



VIEW D-D
SHOWN WITH COVER REMOVED



VIEW C-C
SHOWN WITH COVER REMOVED

NEXT ASSY	REF SPEC'S
APPLICATION	

UNLESS OTHERWISE SPECIFIED –
DIMENSIONS ARE IN INCHES
TOLERANCES ON FRACTIONS ± 1/64
DECIMALS .X ± .03, .XX ± .01,
.XXX ± .005
ANGLES ± 1/2° BENDS 90°
FABRICATE PER SPEC 89-002-000

MATERIAL –

APPEARANCE –

FINISH –

CONTRACT		
AUTHENTICATION		DATE
DRAFTSMAN	[illegible]	11/28/60
CHK		
REVIEW		
ENGR	[illegible]	12/28/60
APPD	[illegible]	12/29/60

WESTON – ROTEK
19__

REF D M NONE

WESTON INSTRUMENTS INC.
LEXINGTON DIVISION LEXINGTON MASS

SCHEMATIC & LOCATION
111 PLUG-IN

SIZE	CODE IDENT NO.	DRAWING NO.
D	11842	04-117-511-B
SCALE NONE	UNIT WT	SHEET 2 OF 2

04-117-511

SECTION 6

REPLACEABLE PARTS

This section contains ordering information for replacement parts listed by assembly and model. Where manufacturer and type are not given (designated by **), parts may be ordered directly from Weston-Lexington. These parts should be identified by Weston-Lexington part number; the instrument model number and serial number should also be specified.

Following is a list of assemblies included in this section:

Name	Page
Main Assembly	6-2
Switch Board 1	6-3
Switch Board 2	6-4
Voltage Divider Board 5	6-5
Voltage Divider Board 6	6-6
Voltage Divider Board 7	6-7

MAIN ASSEMBLY 04-117-511

REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
	Panel, Front	08-117-161	Weston	--
	Knob, Extractor	03-117-200	Weston	--
	Latch, Panel	07-117-377	**	--
	Insulator, Connector BNC	08-117-366	Weston	--
	Plate, Rear	03-117-367	Weston	--
	Knob, Front Panel	08-117-372-1	**	
	Knob, Front Panel	08-117-372-5	**	
P6	Connector, Male, 32 Pin	29-033-232	Amphenol	26-4100-32P
J111	Connector, BNC Receptacle	29-057-001	Amphenol	31-105
SW10	Switch, Detent & Shaft	34-063-999-9	**	--
SW12	Switch, Detent & Shaft	34-063-999-10	**	--
SW11	Switch, Detent & Shaft	34-063-999-11	**	--
R134	Resistor, Variable, 10K	40-419-001	Allen-Bradley	Type J

SWITCH BOARD 1 04-117-511

REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
SW13,14,15,16	Switch, Pushbutton, 6 Pole, 12 Pos.	34-074-001	**	--
R87,92,97	Resistor, Variable, 2K	40-421-001	Mallory	MTC23L4

SWITCH BOARD 2 04-117-511

REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
R86,91,96	Resistor, Film, 7.68K, 1W, 1%	40-002-076	IRC	CEC
R98	Resistor, Film, 226.05Ω, 1W, 0.1%	40-016-142	IRC	CEC
R93	Resistor, Film, 251.94Ω, 1W, 0.1%	40-016-143	IRC	CEC
R88	Resistor, Film, 254.66Ω, 1W, 0.1%	40-016-144	IRC	CEC
R85	Resistor, Film, 1800.1Ω, 1W, 0.1%	40-016-158	IRC	CEC
R90,95	Resistor, Film, 1981.4Ω, 1W, 0.1%	40-016-160	IRC	CEC

VOLTAGE DIVIDER BOARD 5 04-117-511

REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
SW11	Switch, Wafer, 1 Pole, 11 Pos. Shtg.	34-063-207	CTS	212
R85	Resistor, Film, 243K, 1W, 1%	40-002-112	IRC	CEC
R135	Resistor, Film, 1K, .25W, 10%	40-012-001	Allen-Bradley	CB
R43,44	Resistor, Film, 80.6Ω, 1W, 0.1%	40-016-024	IRC	CEC
R25,26,27,28,29,30, 31,32,33,34	Resistor, Film, 806Ω, 1W, 0.1%	40-016-048	IRC	CEC
R35,51	Resistor, Film, 2015Ω, 1W, 0.1%	40-016-054	IRC	CEC
R37,49	Resistor, Film, 1289.6Ω, 1W, 0.1%	40-016-058	IRC	CEC
R41,45	Resistor, Film, 322.3Ω, 1W, 0.1%	40-016-145	IRC	CEC
R101	Resistor, Film, 403Ω, 1W, 0.1%	40-016-147	IRC	CEC
R39,47	Resistor, Film, 725.5Ω, 1W, 0.1%	40-016-153	IRC	CEC
C1	Capacitor, Mica, 20pf, 300V	45-001-003	Electro-Motive	DM15C
C3	Capacitor, Mica, 22pf, 300V	45-002-002	Electro-Motive	DM15E
C2	Capacitor, Variable, 2-8pf	45-504-002	Erie	538

VOLTAGE DIVIDER BOARD 6 04-117-511

REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
SW10	Switch, Wafer, 1 Pole, 11 Pos., Shtg.	34-063-007	CTS	212
SW12	Switch, Wafer, 1 Pole, 11 Pos., Shtg.	34-063-207	CTS	212
R103	Resistor, Film, 22162Ω, 1W, 0.1%	40-016-163	IRC	CEC
R99	Resistor, WW, .36Ω, .25W, .01%	40-147-003	Daven	1274

VOLTAGE DIVIDER BOARD 7 04-117-511

REFERENCE DESIGNATION	DESCRIPTION	W-L PART NO	MANUFACTURER	MFR. TYPE
R30,55	Resistor, Film, 14.7Ω, 1W, 1%	40-002-008	IRC	CEC
R68,69	Resistor, Film, 80.6Ω, 1W, 1%	40-002-026	IRC	CEC
R67,70	Resistor, Film, 324Ω, 1W, 1%	40-002-040	IRC	CEC
R66,71	Resistor, Film, 732Ω, 1W, 1%	40-002-047	IRC	CEC
R53,54,55,56,57,58, 59,60,61,62,63	Resistor, Film, 806Ω, 1W, 1%	40-002-048	IRC	CEC
R65,72	Resistor, Film, 1.27KΩ, 1W, 1%	40-002-056	IRC	CEC
R64,73	Resistor, Film, 2.05KΩ, 1W, 1%	40-002-062	IRC	CEC
R10,12	Resistor, Film, 3.32KΩ, 1W, 1%	40-002-067	IRC	CEC
R16,23	Resistor, Film, 146.53Ω, 1W, 0.1%	40-016-022	IRC	CEC
R1-9	Resistor, Film, 80.6Ω, 1W, 0.1%	40-016-024	IRC	CEC
R15,17	Resistor, Film, 82.5Ω, 1W, 0.1%	40-016-025	IRC	CEC
R18,22	Resistor, Film, 87.93Ω, 1W, 0.1%	40-016-026	IRC	CEC
R14,24	Resistor, Film, 219.8Ω, 1W, 0.1%	40-016-032	IRC	CEC
R19,21	Resistor, Film, 43.96Ω, 1W, 0.25%	40-017-001	IRC	CEC
R11,13	Resistor, Variable, 750Ω	40-420-001	Mallory	MTC751L1

SW-10B

SW-10A

SW-11

SW-12

SW-13

SW-14

SW-15

SW-16

VD-7 BD

VD-6 BD

VD-5BD

SEE NOTE NO 4

R135 1K 1% 1/4W

C3 22pf

C2 2-8pf

C 20pf

R1 80.6 .1%
R2 80.6 .1%
R3 80.6 .1%
R4 80.6 1%
R5 80.6 1%
R6 80.6 .1%
R7 80.6 .1%
R8 80.6 .1%
R9 80.6 .1%
R10 3.32K 1%
R11 750
R12 3.32K
R13 750
R14 219.8 .1%
R15 82.5 .1%
R16 146.53 .1%
R17 825 .1%
R18 87.92 .1%
R19 43.96 .5%
R20 14.7 1%
R21 43.96 .5%
R22 87.92 .1%
R23 146.53 .1%
R24 219.8 .1%
R55 14.7 1%

R25 806 .1%
R26 806 .1%
R27 806 .1%
R28 806 .1%
R29 806 .1%
R30 806 .1%
R31 806 .1%
R32 806 .1%
R33 806 .1%
R34 806 .1%
R35 2015 1%
R37 1289.6 .1%
R39 725.5 1%
R41 322.3 .1%
R43 80.6 .1%
R44 80.6 .1%
R45 322.3 .1%
R49 1289.6 1%
R51 2015 1%
R99 .3Ω ±.01Ω 1/4W

R53 806 1%
R54 806 1%
R56 806 1%
R57 806 1%
R58 806 1%
R59 806 1%
R60 806 1%
R61 806 1%
R62 806 1%
R63 806 1%
R64 2.05K 1%
R65 1.27K 1%
R66 732 1%
R67 324 1%
R68 80.6 1%
R69 80.6 1%
R70 324 1%
R71 732 1%
R72 1.27K 1%
R73 1.05K 1%
R101 403 .1%
R103 22162 .1%

R134 10K
R84 243K 1%

R85 1800.1 .1%
R86 7.68K 1%
R87 2K
R88 254.66 1%
R90 1981.4 .1%
R91 768K 1%
R92 2K
R93 251.94 .1%
R95 1981.4 .1%
R96 7.68K 1%
R97 2K
R98 226.05 .1%

VD-5 BD

VD-6 BD

SW-1 BD

SW-2 BD

J-1

INPUT CONNECTOR P6

CASE GND

SEE NOTE 5

04-117-511

NOTES:

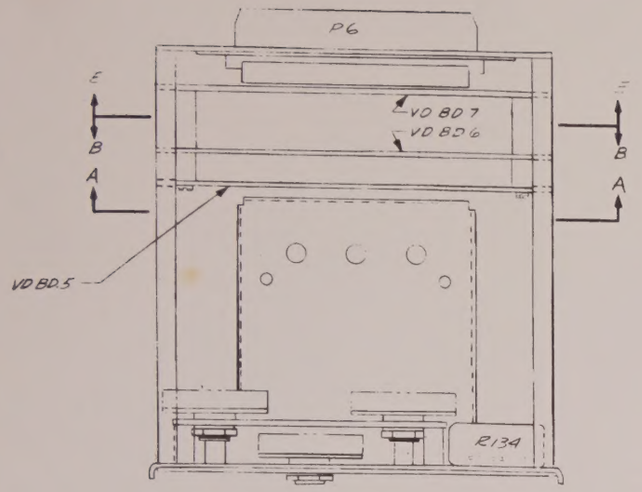
1. UNLESS OTHERWISE SPECIFIED: RESISTOR VALUES ARE IN OHMS. CAPACITOR VALUES ARE IN pF.
2. LAST RESISTOR USED IS R135 LAST CAPACITOR USED IS C3
3. SYMBOL IDENTIFICATION:
   - A. □ - INPUT CONNECTION
   - B. ○ - VD-5 BOARD CONNECTION
   - C. ⬡ - VD-6 BOARD CONNECTION
   - D. ▽ - VD-7 BOARD CONNECTION
   - E. ◇ - SW-1 BOARD CONNECTION
   - F. △ - SW-2 BOARD CONNECTION.
4. ON SERIAL NO'S 101-135 R135 IS 3.3K, 1/4W 5%.
5. NUMBERS SHOWN AT SWITCH TERMINALS INDICATE SWITCH FUNCTION DESIGNATION, NOT SWITCH TERMINAL NUMBER.

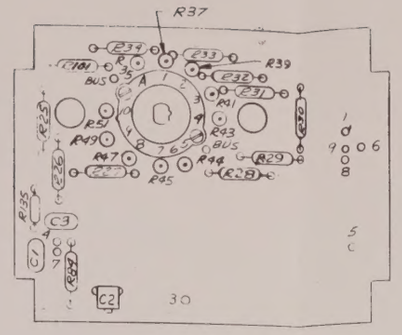
WESTON-ROTEK

D. RODERICK

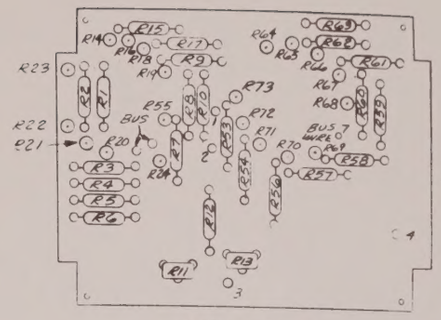
SCHEMATIC & LOCATION III PLUG-IN

D 04-117-511 1 2 B

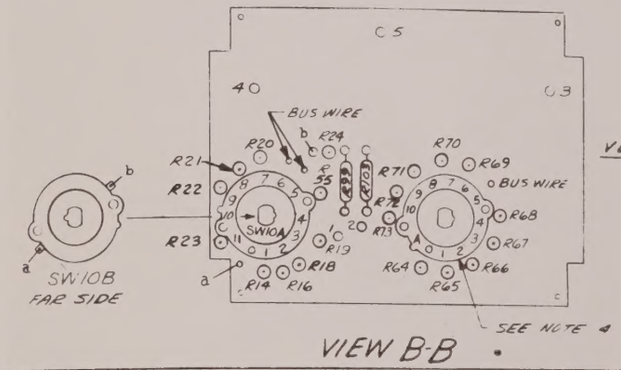




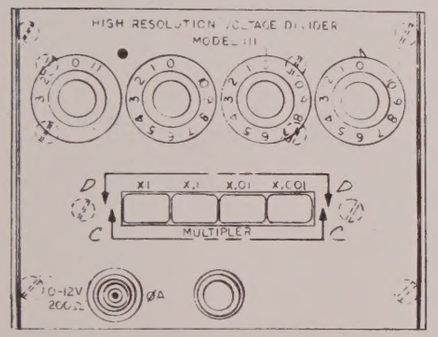
VIEW A-A

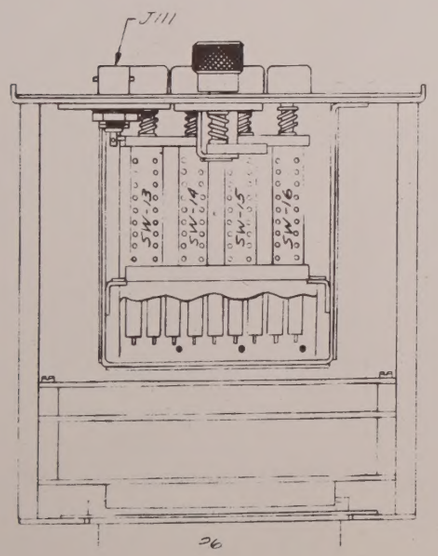


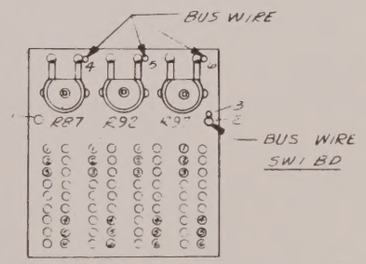
VIEW E-E



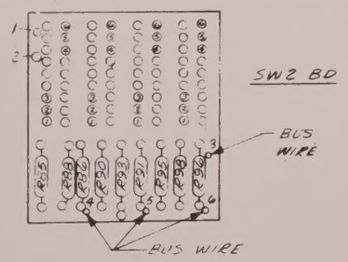
VIEW B-B







VIEW D-D
SHOWN WITH COVER REMOVED



VIEW C-C
SHOWN WITH COVER REMOVED

		UNLESS OTHERWISE SPECIFIED – DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ±1/64 DECIMALS .X ±.03 .XX ±.01 .XXX ±.005 ANGLES ±1/2° BENDS 90° FABRICATE PER SPEC 89-002-000	CONTRACT	REF D M NONE
			AUTHENTICATION / DATE	WESTON INSTRUMENTS INC. LEXINGTON DIVISION LEXINGTON MASS
			DRN [illegible] 11/26/65	SCHEMATIC & LOCATION III PLUG-IN
			CHK	
			REVIEW	
		MATERIAL –	ENGR AR 1/20/66	
		APPEARANCE –	APPD [signature] 7/13/67	
		FINISH –	WESTON – ROTEK 19	SIZE D / CODE IDENT NO 11842 / DRAWING NO 04-117-511-B
NEXT ASSY	REF SPECS			SCALE NONE / UNIT WT / SHEET 2 OF 2
APPLICATION				

04-117-511

Loose Leaf Industries, Inc.
HILLSIDE, N.J.

MP MASTER
MA35435